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User's Manual for the Model Interface and Plugboard Cabinets in the 14- by 22-Foot Subsonic Tunnel

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Abstract

The primary method of connection between the wind tunnel model instrumentation and the data acquisition system in the 14- by 22-Foot Subsonic Tunnel is through the Model Interface (MIF) and Plugboard cabinets. The MIF and Plugboard cabinets allow versatility in the connection of the instrumentation to the different data systems in the facility. The User's Manual describes the components inside the MIF cabinet, the input and output of the MIF, the MIF patchboard, and the Plugboard cabinets. There are examples of standard connections for most of the instrumentation used in the facility.

Introduction

A system has been developed for the 14- by 22-Foot Subsonic Tunnel which provides flexibility in connecting instrumentation to the Data Acquisition System (DAS) and other facility data systems. This system consists of four Model Interface (MIF) cabinets or racks and four plugboard cabinets, as shown in figure 1. The MIF cabinets are portable and can be used in any of the six test sites within the facility (test site 1 is the wind tunnel, test sites 2 to 5 are in the Model Preparation Area, and test site 6 is the Rotor Test Cell). Each MIF cabinet has sets of instrumentation receptacles, power supplies, signal interfaces, and a patchboard. The plugboard cabinets are located in the Control Room of the facility. The plugboards serve as a distribution area. Incoming signals from the MIF cabinets (at the different test sites) and other signal sources are distributed to the DAS and other data systems. The DAS consist of two static systems and a dynamic system. Typically an instrument is connected to the MIF cabinet for power, signal conditioning, etc. and then it is routed to the plugboard cabinets and into the DAS. The information in this Manual briefly describes each component and its function in the system. Further information on the components can be found in the individual manuals for the various components. All of the manuals and reference material referred to in these procedures are available through the Facility Manager, the Facility Safety Head, the Technical Support Section Unit Supervisor, or the Technical Support Section Unit Group Leaders.

System Description

Model Interface Cabinet Components

Instrumentation interface between the wind tunnel models and the Data Acquisition System (DAS) at the 14- by 22-Foot Subsonic Wind Tunnel is accomplished through a Model Interface (MIF) cabinet (fig. 2). There are four MIF cabinets, one for each model support cart in the facility. It is on these carts that wind tunnel models are assembled prior to the test entry into the wind tunnel. If necessary, two MIF cabinets can be used together at a test site to allow for twice the channel capability. The instrumentation input to the cabinet is located on the right side of the cabinet and the output from the cabinet is on the left side, as shown in figures 2(a), 3, and 4.

The MIF cabinet provides regulated direct current (DC) for instrumentation and an interface between the model and the data acquisition system. It provides for signal conditioning and can be used as a stand-alone read-out system. Each unit is designed to accommodate up to three parallel-wired balances, 48 analog signals, 8 digital signals, two Q-Flex attitude transducers, 8 frequency signals, 24 Iron-Constantan thermocouples, 12 auxiliary channels to handle low voltage power, and two video signals. The MIF cabinet utilizes a three-wire patchboard for analog signal inputs allowing for a high degree of versatility in signal conditioning and signal routing. The MIF cabinet is composed of several different components. Each component is designed to interface with specific instrumentation. Some of the components have the capability of being controlled by the DAS.

Power Supplies. Each MIF cabinet unit utilizes four 50 volt direct current (VDC) power supplies, Hewlett Packard (HP) Model No. 6114A. The power supplies are numbered according to figure 2(b). Each power supply has a voltage/current switch, selectable meter, a thumb wheel voltage adjustment, and a current limiting adjustment. Each power supply has voltage sense capability and has a voltage monitor connection on the MIF patchboard. These power supplies are normally used to power strain gage balances. However, there is provision to use one or two of these power supplies to provide voltage for up to 24 DC-powered devices other than the balances. The NEFF 300 signal conditioner is the primary voltage supply for DC powered devices and instrumentation other than strain-gage balances.

Figure 5 shows the DC power supply distribution panel located in the upper back portion of the MIF cabinet. The output of the four DC power supplies can be patched to provide power for a variety of instrumentation power requirements.

Normally one of the three methods listed below would be used:

1. The following method provides for four different voltage levels, three parallel wired balances and up to 24 DC devices not utilizing the NEFF 300.

   Power Supply 1 connected to six component Balance Input 1.

   Power Supply 2 connected to six component Balance Input 2.

   Power Supply 3 connected to six component Balance Input 3.

   Power supply 4 would not be used unless there were requirements to power devices not powered by the NEFF 300. Then Power Supply 4 could be used to provide power to Wheatstone Strain Gage (WSG) input 1 to 24. (Requires an interface cable between WSG 1-12 and WSG 13-24 on power distribution panel, as shown in figure 5).

2. If less than two balances are used and there is a need for two different voltage levels on your analog channels then:

   Power Supply 1 connects to six component Balance Input 1.

   Power Supply 2 connects to six component Balance Input 2

Power Supply 3 connects to WSG input 1-12.

Power Supply 4 connects to WSG input 13-24.

3. The most frequently used method is one balance and all analog channels are at the same voltage level.

   Power Supply 1 connected to the six component Balance Input 1.

   Power Supply 2 is not used.

   Power Supply 3 is not used

   Power Supply 4 is not used.

   Each of the 48 analog channels has a separate power supply in the NEFF 300. Note: Further information can be obtained from the Hewlett Packard Model 6114A power supply operating manual.

Balance Potentiometers. The balance potentiometers or "balance pots" on the MIF cabinet and the balance adjustment on each channel in the NEFF 300 serve the same function. Either one can be used for an analog channel, but not both. The balance pots were initially placed in the MIF cabinet to be used with the previous analog interface. This analog interface did not have a built-in balance pot and had to use the ones in the MIF cabinet. Each MIF cabinet has twelve balance potentiometers, which can be connected into any of the analog channels. The balance pots are mounted on a panel immediately below the patch panel and are marked "Balance Pots", as presented in figure 2(a) and (b). To utilize the balance pots, the instrumentation must be connected into one of the twelve 5-pin XLR receptacles on the right-hand side of the MIF cabinet (fig. 3). These receptacles are labeled "Balance Pots." Each balance pot must to be connected on the patchboard between the appropriate receptacle in Row 1 and one of the "Bal. In" receptacles in Row 7 (see fig. 6). The corresponding "Bal. Out" receptacle in Row 8 would then patch to the appropriate receptacle in the MODCOMP row, Row 5. Signal changes can then be made by adjusting the appropriate balance pot (fig. 2(b)). For example, the balance pots in the MIF cabinet (and the balance adjustment in the NEFF 300) may be used to adjust the instrument's output voltage to zero at a zero or reference load. Another example is setting a specific output voltage for a specific load or condition, 20 mV at full scale load.

Analog Digital Voltmeter Selector. The analog digital voltmeter (DVM) allows for selection and display of the 48 analog channels (fig.2(b)). There is a double digit thumbwheel switch for channel selection and a DVM for voltage display. The useful range of the switch is 00 to 48 and the DVM will read from micro-volts to volts. The unit has an on-line/off-line switch. In the on-line mode, the unit will display the selected channel. The off-line mode removes the unit from the circuit. There is a "channel short" switch which allows for short-circuiting a channel to drive the reading on that channel to zero. There is a patch receptacle in Row 6 of the patchboard marked "DVM", which is connected to channel zero on the thumbwheel switch (fig. 6(d)). With the thumbwheel set to zero, any input into this receptacle will display on the DVM.

This unit can also be used as a stand-alone data read-out system as well as used for instrumentation set-up and trouble-shooting. Channel output voltages can be displayed on the DVM by setting the desired channel number on the thumbwheel switch. The channel number on the thumbwheel corresponds to the MODCOMP channel number on row 5 of the patchboard. The DVM should be set on DC and the proper voltage range should be selected. Normally, using the display of the channel output voltage it can be determined if the instrumentation is functioning properly. When holding down the channel "short" switch the display should indicate a value close to zero, which would indicate a good bridge circuit through the instrumentation connected to this particular channel. This unit allows readout of the instrumentation locally without having to go through the DAS. If a good reading is established at this point, any problem indicated at the DAS would be between the MIF cabinet output and the input to the DAS. This unit is a good check of the patchboard connections. A properly patched channel would display on the DVM when that particular channel is selected. Normally this unit is operated in the on-line mode to use local readout. (The off-line mode was added to prevent any possible feedback into the DAS). More information on this unit is available in the "Analog DVM Selector" manual.

Tachometer Interface. The Tachometer Interface (TIF) provides interfacing for frequency inputs to the DAS. The TIF has eight input channels (fig. 3). Each channel has four switch selectable ranges to cover frequencies from 0.01 to 999,999 Hz. Each of the eight channels can be displayed on the front of the TIF on the light emitting diode (LED) display (fig. 2(a)). There is a selector switch to determine which channel is displayed. Each channel has a four position, range select switch. There is a two position switch marked RUN and TEST. Normally, this switch should be in the RUN position. The TEST position provides for maintenance and operational checks. There is a test frequency switch which in conjunction with the range switch will determine what frequency is displayed on the

LED. With the TEST position selected and range selector set at 1 there will be a direct correlation between the test frequency set and the value displayed. For example, with the range set at 1 and a test frequency of 10 selected. The value of 10 is displayed on the LED.

Normally frequency output is converted to a digital signal by connecting the output from the TIF to the Digital Interface (DIF), through available interface cables at the MIF cabinet (fig. 2(d)). The TIF has eight individual output receptacles on the right-hand side of the MIF cabinet (fig. 3) and there are eight DIF inputs immediately below them. There is a one-to-one correspondence between the TIF input and the TIF output. The TIF output would go to the DIF input according to the channel assignment designated by the test set-up. There is also a TIF output on the left-hand side of the MIF cabinet (fig. 4). This output receptacle is on the TIF output panel and is marked "SIG OUT", and the output carries all eight TACH output channels in a single cable. This output can be carried to the Control Room as a conditioned frequency instead of sending it over a digital channel.

There is an off-line/on-line switch and a red indicator light. In the off-line mode, the red light will be lit and the TIF unit will perform normally except there will be no computer control of range selection. In the on-line mode, range control can be accomplished through software by the DAS. Range selection is explained in detail in the DAS Users Manual. There are eight pots (one for each channel) to adjust the threshold level of each TIF channel. These potentiometers are accessible from the rear of the MIF cabinet through the top of the TIF unit.

Typical use of the TIF unit is for a revolutions per minute (RPM) input: 1) Input signal to TIF input 1 and patch TIF output 1 to digital input as dictated by test program (could be any digital channel 105 through 112). 2) Place the TIF in the off-line mode, TEST/RUN switch in RUN, and select 1 for channel 1 (frequency input can be from model or from a frequency generator). 3) While watching TIF display, adjust threshold potentiometer, at top-rear of TIF, until signal starts displaying. Display value should be comparable to frequency input. 4) Discontinue frequency input and observe display. If a reading other than zero is displayed, adjust the threshold potentiometer (turn clockwise) until zero is displayed. 5) Input the test frequency again and observe reading on display. The value should not fluctuate, if there is a variation, then re-adjust the threshold potentiometer until a reading is obtained comparable to the input test frequency. 6) Once an acceptable reading is accomplished check and be sure that the proper channel patching is done and that the range in and range out cables are connected at the MIF cabinet. Also, check at the plugboard cabinets in the Control Room and insure that the necessary patching is complete.

NEFF 300. The NEFF 300 is a direct current unit providing power and signal conditioning for 48 analog channels. There is one located in each MIF cabinet (fig 7). The NEFF 300 has variable output supply voltage and has potentiometers for setting the excitation voltage and for adjusting the output signals on DC voltage devices. Figure 7(a) shows a diagram of the NEFF 300 with its front panel open. There are 12 channel cards and one control function card. The 12 channel cards to the left of the unit serve a dual purpose. They function as Input Conditioning Cards and as Strain

Gage Mode Cards. Each card has four channels with the lower numbered channel starting at the bottom. For example, the first card at the left contains channels 1 through 4 starting with channel 1 at the bottom and channel 4 at the top of the card. The second card has channels 5 through 8 with channel 5 being the lower channel and channel 8 being the upper most channel on the card. This sequence continues through the remaining ten cards.

Each card has five user accessible functions associated with each of the four channels on that card. (Fig. 7(b))

1. The first control is a trim potentiometer that allows for the adjustment of the output of the device that is utilizing that particular channel.

2. The second control is the trim potentiometer for the excitation voltage. This potentiometer allows for fine adjustment of the excitation voltage for a specific channel.

3. The third control is a voltage selection dip switch. The table in fig. 7(c) shows the various values that are available and the necessary switch positions. Normally the voltages are preset to 5.0 VDC, however, if the need for other voltages arises the capability exists for other voltage ranges between 2.0 to 10.0 VDC.

4. The next control on the card is the resistance calibration (RCAL) selector switch. This is a 10 position switch which allows for

selecting any of 10 resistance values to be used as the RCAL value for that particular channel. Through the MODCOMP software, RCALs can be applied to all of the 48 analog channels utilizing the NEFF 300. The table in figure 7(d) shows the various resistance values available.

5. The 4 pin micro plug on the lower portion of the card is for displaying the excitation voltage of the power supply or for displaying the output of the device connected to that particular NEFF channel. There is a patch cable with each MIF cabinet that is utilized with this plug. The patch cable has a 4 pin micro receptacle on one end. The left side of this receptacle is marked white (NOTE: This white side must face to the left). The micro receptacle of the patch cable connects to one of the 4 pin micro plugs on the card. The other end of the patch cable connects to the DVM through one of two 2-pin banana plugs. The banana plugs are identified with a raised ridge on the minus or low side of the plug. One banana plug is marked "Excitation", and is for displaying the excitation voltage of a channel. The other banana plug is marked "Output", and is for displaying the voltage output of the device utilizing that channel. To perform the following tasks there must be a resistive load in the channel being displayed - a transducer or some other strain gage device. By setting the DVM selector switch to zero and plugging in the banana plug marked "Excitation", the excitation voltage of a particular channel can be displayed on the DVM. Again with the DVM selector switch set at zero and the banana plug marked "Output" plugged into the DVM, the output voltage of a channel can be displayed on the DVM. The

normal operation of the MIF cabinet allows for displaying the output of devices utilizing the 48 analog channels, therefore the above mentioned procedure merely duplicates an existing function of the MIF cabinet.

These control functions could be used while displaying a specific channel on the DVM through use of the patch cable mentioned previously or through direct reading by utilizing the Reference Supply and Relay Driver Card located in the right-hand section of the NEFF 300 (Fig. 7(a)). This card has five toggle switches, an LED indicator, and six potentiometers for card calibration and adjustments. The toggle switches are in the off position when they are down. To utilize the functions of the first four switches, the fifth switch must be in the off-line mode (switch down).

1. The upper-most switch provides for the input of an external voltage such as an EDC voltage standard. The toggle switch would be up, or on. The function this switch provides is not presently available.

2. The second switch allows for displaying the RCAL value for a particular channel on the DVM, provided that that particular channel is selected on the DVM selector thumbwheel. This would require this second switch to be up and should be performed with the card in the off-line mode (fifth toggle switch down).

3. The third switch, marked Excitation Voltage is for displaying the excitation voltage of a selected channel on the DVM. This switch would be switched up and is used in the off-line mode (fifth toggle switch down).

4. The fourth switch is presently not used.

5. The fifth switch is the On/Off-Line switch. The LED lights red when the On/Off toggle switch on the card is switched to the off-line (local) mode (switch down) and goes out in the on-line (remote) mode (switch up). NOTE: To take data through the MODCOMP the On/Off Line switch must be in the on-line (remote) mode - always be sure that after using the NEFF 300 in the off-line mode, that it is put back into the on-line mode (switch up) and the red LED is extinguished. If the NEFF is left in the off-line mode, you will get a message at the MODCOMP data acquisition terminal stating that the NEFF 300 used is off-line. With NEFF off-line, analog channels connected to the NEFF 300 will not acquire data.

NOTE: Make sure that the four switches are used one at a time. If two or more switches are used, an erroneous reading will be displayed.

Digital Interface. Another major component of the MIF cabinet is the Digital Interface (DIF). This unit provides a digital interface between the model and data acquisition system. The DIF has eight inputs, see figure 3. Instrumentation which utilize the DIF are encoders, frequency inputs (outputs from the TIF), digital pressure transducers, and BCD output devices (fig. 2(d)).

The DIF has two output capabilities. Normally the DIF output is through the "MUX out" (multiplexed output) receptacle on the left side of the MIF cabinet (see fig. 4). This receptacle carries all eight of the digital channels on one cable marked "DIF MUX" cable. These cables run from each test site to the plugboard cabinets in the Control Room. Test sites 1 and 6 both have two "DIF MUX" cables. The other test sites have only one "DIF MUX" cable. The other output of the DIF is through the "Single Ended Output" receptacles on the left-hand side of the MIF cabinet (fig. 4). These receptacles are parallel outputs of the DIF and are used anytime there is a requirement for the digital signal from the DIF to be sent to something other than the DAS. An example is when the roll sting is used. The three encoder readings from the roll sting must go to the micro-processor control console as well as to the DAS. The digital input to the control console utilizes the "single-ended output" cables.

The DIF unit has an LED display, error indication lights, a power switch, an on-line/off-line switch, and a thumbwheel switch for channel selection. The LED digital display shows the output of the selected channel. Selection is made by the thumbwheel switch (Note: Some of the DIF units have a thumbwheel switch labeled 0 through 7; the other units have thumbwheel switches labeled 1 through 8). The four indicator lights indicate errors and the mode of output of the DIF. With mode switch set to off-line, the unit can be used as a stand alone readout system for digital information. The unit has an internal sign change switch for each channel. On the initial test set-up, each digital channel can be displayed and the device output checked as it is connected. An error light indicates a bad channel input. Bad cables and/or instrumentation may cause error indications. The on-line mode must be selected for acquiring data through the DAS. An off-line DIF will indicate at the MODCOMP control terminals and in the computer room on the Digital Input Buffer unit (DIB). DIB units are located in the utilities cabinet next to the NEFF 600 cabinet in the Computer Room (room 201). Each DIB can handle 16 digital inputs. See the Digital Input Interface Manual for a more complete description of the DIF and see the Digital Input Buffer Manual for more information on the DIB.

Q-Flex Control Box. The Q-Flex control box provides power and signal conditioning for two Q-Flex attitude transducers. Each control unit is identified with the controls for unit 1 being on the left side of the front panel and those for unit 2 on the right side (fig. 2(a)). This numbering correlates to the AOA(angle of attack) inputs 1 and 2 on the right hand side of the MIF cabinet (fig. 3). This numbering also correlates to the two patch receptacles in row 6 marked AOA 1 and 2 on the patchboard (fig. 6(a)). These two receptacles would patch to the designated receptacles in row 5 - MODCOMP (fig. 6(d)).

This unit has the following function selections: "MV/G sensitivity", "Filter Time", a common "test point" selector, and a common LED display. The display is common to both unit 1 and 2 and displays according to the setting of the "Test Point" selector. The left side is dedicated to unit 1 readings and the right side dedicated to unit 2 readings. The display reads in volts or multiples of volts, depending on "Test Point" selection. The unfiltered selection usually indicates in millivolts. The "filter time" selector determines the amount of filtering done on input signals, usually it is set at the "short" selection. The "mV/G sens" (millivolts per gram) control sets the sensitivity of the instrument. Normally this should be set at 0.100 on the scale. This setting could be some other value if more or less sensitivity is desired. <u>NOTE:</u> **This sensitivity setting directly affects the calibration of the AOA instrument and should not be changed after AOA calibration has been performed. If a change in sensitivity becomes necessary, the AOA instrument would require a new calibration.**

A Q-Flex input receptacle is provided on the front panel, which allows for checking Q-Flex instruments at the MIF cabinet. To do this, plug in a Q-Flex unit, set "Test Point" to unfiltered, and observe the display on the Q-Flex control box. Tilting the Q-Flex should provide a corresponding reading change on the display. A toggle switch on the front panel is provided for internal test of the control box itself. More information is available in "Q-Flex Set-up Procedure," available through the Facility Manager and/or the Technical Support Section Unit Group Leaders.

Thermocouple Reference Junction. This is the lower unit in the MIF cabinet (fig. 2). This unit provides for a thermocouple (T.C.) input which is converted to an analog output. This unit is an ice point thermocouple reference system. It can handle 24 Iron Constantan thermocouple inputs. Input to this unit is on the right hand side of the MIF cabinet (fig. 3). Signals out of the reference junction are patched from Row 6 to Row 5 on the patchboard (figs. 6(a) and (d)). More information on this T.C. unit is available in the Kaye Model 170 literature. Other thermocouple types can be used but will need an ice point reference junction prior to connection to the MIF cabinet.

MIF Cabinet Input

All signal inputs to the MIF cabinet are located on the right side, as shown in figures 2 and 3. Input signals include all balances, model attitude sensors (Q-Flex), analog signals, digital signals, and frequency signals. There are also two video inputs, which are wired straight through the cabinet.

Balances. The top set of receptacles on the right side of the MIF cabinet is used for parallel wired balances or for balances using a parallel wired adapter. Normally, this covers all balances used in this facility. There are inputs for three balances. The balances must be powered from one of the four HP power supplies in the top of the MIF cabinet. The power is patched to the balance at the Power Distribution Panel in the top back of the MIF cabinet (see previous section on POWER SUPPLIES). The balance inputs must be patched through the patchboard on the front side of the MIF cabinet (figs. 6(a) and (d)).

Attitude Transducers. The second set of receptacles is for attitude accelerometers, Q-Flexes. The Q-Flex control box is capable of handling two instruments. It has signal conditioning controls and an LED readout. The filter setting should be set to the short selection. The sensitivity should be at 100 mV/G. The LED display reads in millivolts. The selector switch serves both inputs to the control box. The left side of selector switch is for Q-Flex 1 and the right side is for Q-Flex 2. If necessary, an additional Q-Flex control box could be utilized and its output plugged into the MIF cabinet on a WSG Input or through an auxiliary input and properly connected at the patchboard (figs. 2(e) and 6(d)).

WSG Inputs. The plugboard on the right-hand side of the MIF cabinet marked "WSG" or "SG" is for input of most analog type instruments (fig. 2(c)). This covers strain gages, potentiometers, accelerometers, and most analog output instruments used in this facility. These receptacles can be powered through either the NEFF 300 or the HP power supplies in the MIF cabinet, depending on how the patchboard is configured. The power to and the signal from these receptacles must be patched through the patchboard.

Balance Potentiometers. DC type devices such as strain gages which require balancing, or require an offset can use these controls. Properly patched, these circuits have a ten-turn potentiometer wired into the system as a voltage divider network. These must be patched through the patchboard (fig. 6(a)). These inputs would be used instead of the "WSG" inputs. The NEFF 300 also has the capability of providing the same type of signal conditioning and will normally be used rather than using these balance pots.

Tachometer Inputs (also TIF input). These are for most frequency generating type instruments; such as RPM tachometers, etc.

Tachometer Interface (TIF) output These receptacles allow the output of conditioned frequency signals from the tachometer interface to be patched into the Digital Interface inputs.

Digital Interface (DIF) Inputs. Any instrumentation which is to be displayed as digital information at the MODCOMP, such as, frequency, encoders, and BCD output type devices, would use these inputs.

Iron Constantan Thermocouples. There are 24 Iron Constantan (I.C.) type thermocouple (T.C.) inputs. The thermocouple signals go into an ice point reference junction. The output signals from the reference junction terminate at the 24 patch receptacles marked "T.C." on the patchboard (fig. 6). The output of the reference junction is in millivolts.

Video Inputs. These are wired with and designed to be used with RG-59 coax cable primarily for video equipment, but could be used for AUX coax cables.

Auxiliary BNC Inputs These allow for the connection of RG-58 coaxial cable. There is a wide variety of instruments which use this type of cable. Usually frequency monitoring equipment or dynamic output devices utilize these inputs.

Auxiliary Inputs These 12 plugs can be utilized for small D.C. Motor Drives, control valves, or anything requiring a shielded pair of conductors. These inputs must be patched through the patchboard (fig. 6(a)).

MIF Cabinet Output

Output signals from the MIF cabinet are on the left side. These signals are connected to the Data Acquisition System or other devices by cabling from each test site in the facility to the plugboard cabinets in the Control Room.

Analog. These top 3 plugs, each carry 16 analog channels, and route the signal from the test site to the plugboard cabinets in the Control Room. These are outputs which come from the patch row marked "MODCOMP" on the patchboard. (fig. 6(a))

DIF. The "MUX-OUT" (multiplexed output) plug carries the 8 digital channels from the DIF (fig. 4). The single-ended output allows each of the 8 digital channels to be routed paralleled to somewhere other than the MODCOMP. An example of this is when encoder readings from the roll sting are sent to the micro-processor control system as well as to the MODCOMP.

TIF. The signal out lead carries all 8 TACH inputs from the TIF up to the Control Room and allows for more signal conditioning that may be required in special cases. The "range in" and "range out" plugs are for range control through MODCOMP software. (fig. 4)

Video and Auxiliary (AUX) BNC. Video out and AUX. BNC out are wired straight through the MIF cabinet from the corresponding inputs. (fig. 4)

Auxiliary Out. Twelve AUX outputs which can be patched through patchboard (fig. 6(a)). These are two conductor shielded cables suitable for a variety of uses (fig. 4).

Model Interface Patchboard

The patchboard inside the MIF cabinet allows versatility in the connection and routing of signals and power. The patchboard has eight rows of 3-pin receptacles and are described below and presented in figure 6.

ROW 1 - NEFF Power Supply. This row is connected to individual power supplies in the NEFF 300, and allows for instrumentation of different voltage requirements to be used at the same time through one MIF cabinet (Fig. 6(a)). The NEFF 300 has user selectable voltages of 2 to 10 VDC.

ROW 2 - Excitation voltage. This row contains the 48 receptacles for WSG voltage inputs on the right side of the MIF cabinet (figs. 2(c) and 6(b)). The power supply row (row 1) must be patched to the excitation voltage row (Row 2) in order to have power at the 48 receptacles marked WSG inputs on the side of the MIF cabinet. Normally this patching is done one to one and in consecutive order, that is, one is patched to one, two to two, three to three; etc. Instead of using the NEFF power, one of the four HP power supplies, could be patched to provide power to specific channels in row 2. In this instance, the power from the PS1 or PS2 sections of row 8, is connected to one or two of the HP power supplies. The HP power supplies would have to be plugged into the appropriate receptacles on the power distribution panel in the back of the MIF cabinet (See figures 5 and 6 - Row 8). Available power from the HP power supplies is from 0 to 50 VDC.

ROW 3 - Signal out. This is the signal from the 48 WSG inputs on the input side of the MIF cabinet (fig. 3). If an unconditioned signal is required, this would patch down to the required channel in the MODCOMP row (Row 5) (figs. 6(b) and (c)). Note: The signal lead from the WSG input is sent to two places on the patchboard. One is to the "SG Out" row and the other is to the input of the correspondingly numbered NEFF 300 channel. This provides an unconditioned signal from the receptacles in the "SG Out" row 3 or a NEFF 300 conditioned (see NEFF 300 manual) signal from the receptacles in the NEFF OUT row 4 (figs. 6(a), (b), and (c)).

ROW 4 - NEFF Out. This is the output from the NEFF 300 and must be patched to the proper channel in the MODCOMP row, Row 5, if the NEFF is to be used in that channel. The NEFF 300 is used to provide signal conditioning to an analog channel. (figs. 6(b) and (c)).

ROW 5 - MODCOMP. This row connects to the three MODCOMP output receptacles on the output (left-hand) side marked analog 1-16, 17-32, and 33-48. The analog output goes to the plugboard cabinet in the Control Room and is then patched to the desired data acquisition system (DAS) (static and dynamic).

ROW 6. The first 21 patch receptacles in this row are allotted to the 3 parallel wired balances (figs. 6(c) and (d)). These receptacles are the output from the three groups of six 5 pin receptacles on the input side (fig. 3). Seven patch receptacles are used by each balance and are marked accordingly (fig. 6). For a standard NASA six component balance, the first receptacle in each of the three groups is the first balance channel or normal force, the second is axial force, the third is pitching moment, the fourth is rolling moment, the fifth is yawing moment, the sixth is side force, and the seventh is the voltage monitor receptacle. These channels are patched to the row marked MODCOMP according to test set-up requirements. The voltage monitor is used to monitor and maintain the balance voltage at a specific value. (fig. 6(d)). The receptacle 22 in this row is marked "DVM". This can be used in conjunction with the digital voltmeter mounted in the MIF cabinet. By setting the channel selector thumbwheel adjacent to DVM display to zero, any input into this patch receptacle will read on the DVM. This option could be used when setting up a test or when trouble-shooting instrumentation problems. Receptacles 23 and 24 are designated AOA 1 and AOA 2 (fig. 6(d)). These receptacles provide the output of the AOA (Q-Flex) control box and must be patched, according to the test set-up, to the required receptacle in the row marked MODCOMP. The final 24 receptacles in this row are marked T.C. I.C. 1 thru 24. These are Iron Constantan thermocouple output converted to millivolts from the T.C. Ref. Junction. These must be patched to the prescribed receptacle in the row marked MODCOMP (figs. 2(e) and fig. 6(d)).

ROW 7. The first 12 receptacles in this row are dedicated to the 12 balance potentiometers (bal. pots.) and are marked "bal. power in". When using bal. pots. you would patch the power into these patch receptacles (fig. 6). The next 12 receptacles in row 7 are from the auxiliary inputs on the input side of the MIF cabinet. The next 4 patch receptacles marked "P.S. MON." are outputs from the four HP power supplies and are used to monitor the voltage output from these power supplies. The next 8 patch receptacles are marked "Voltage Divide In and Out". The first four are for patching to the voltage divider and the next four are for patching the output from the voltage dividers. The voltage dividers would be used whenever there are voltages above 10 V.D.C. because the MODCOMP's voltage limit is 10 VDC. The last 12 patch receptacles in row 7 are not used presently.

ROW 8. The first 12 patch receptacles in row 8 marked "Bal. Sig. Out" are the output from the bal. pots. If bal. pots. are used, the power would be patched to the "Bal. Pwr. In", in row 7 and the signal out would be patched from the "Bal. Sig. Out" receptacles in row 8 to the appropriate channel in the MODCOMP row (row 5). The next 12 patch receptacles in row 8 marked "Aux. Out" are the outputs for the auxiliary channels. Both the "Aux. In" and the "Aux. Out" could be used in a variety of ways. One instance would be using a corresponding "Aux. Out" for the "Aux. In" being used. Some test requirements may call for an input from "Aux. In" to be patched directly to a MODCOMP channel in row 5 or for the output of a voltage to be patched through an "Aux. Out" receptacle. The next 24 patch receptacles are divided into two groups. Both groups are for D.C. power and are connected to the D.C. power distribution panel in the back of the

MIF cabinet. Both groups, all 24 channels, can be powered from one of the HP power supplies or they can be divided into two groups of 12 and each group of 12 can be connected to a separate HP power supply.

The MIF cabinet patchboard allows for a considerable amount of flexibility in connecting instrumentation between the model and the DAS, therefore it is important to keep the following in mind: 1) The MIF cabinet has the capability of interfacing 48 analog channels, and 8 digital channels where as the MODCOMP has 96 analog and 16 digital channels. 2) There may or may not be a one to one correlation between channels in the MIF cabinet and channels on the MODCOMP. For example, a test set-up might utilize channel 1 through 16 at the MIF cabinet but could end up in channels 49 through 64 at the MODCOMP. 3) One has to be careful to properly patch channels on the MIF cabinet patchboard. Also, make sure which cables are being used from the test site to the patch cabinets in the Control Room. Proper connection of cables from the input side of the MIF cabinet all the way to the plugboard cabinets in the Control Room will insure proper data.

Plugboard Cabinets - Control Room

Signals from the six different test sites are connected to the DAS at the four patch cabinets located in the 14- by 22-Foot Subsonic Tunnel Control Room (fig. 8). The cabinets are numbered from left to right as one is facing them. The contents of each cabinet will be described below.

Cabinet 1. Figure 8(a) shows the current Cabinet 1 arrangement which contains the single-ended digital output, scanni-valve control interface, and voltage calibration connections. The first two rows of three receptacles marked "Roll Sting Tunnel" and "Roll Sting MPA" are used to carry the encoder signals to the microprocessor in the portable Roll Sting Control Console. Depending on the Roll Sting location (test section or Model Preparation Area), these receptacles would be connected to the appropriate plugs in the section marked "Digital Single Ended Output from Test Site". The next set of receptacles marked "Digital Single-ended Output from Test Site" are used to parallel a digital signal to two different locations.

Each test site has the capability of handling 5 single ended digital signals. The sixth single ended digital cabling has been used for other purpose. An example of the single ended digital signal is when the roll sting (alpha/beta sting) is used. The encoder readings, which are digital, must go to the the microprocessor control console as well as to the MODCOMP. The cables going to the microprocessor console would utilize the single ended outputs while the signal going to the MODCOMP would use the regular digital inputs to the DAS.

The middle panel contains receptacles for the scanni-valve cables and is marked "Scanni-Valve Control from test site". Each test site has a control cable and an I.D. cable coming to this panel. The next two panels marked "Scanni-Valve to Modacs" contain receptacles which carry control signals to the MODCOMP via the Modacs. The Modacs is an interface device which allows the MODCOMP to control certain devices. Scanni-valves are no longer used in this facility.

Cabinet 2. The second cabinet from the left, Cabinet 2, contains the TIF range connections, auxiliary connections, and coax and video connections (fig. 8(b)). There is usually a set of 7 or 8 NEFF amplifiers mounted in the top of this cabinet. They are used in the strain-gage balance channels when the Balance Dynamic Display Unit (BDDU) is used. The BDDU is used to monitor the balance dynamic loads, which can be seen on the oscilloscope connected to the unit .

The next set of receptacles down is a Tachometer Interface or "TIF." These are used for any frequency signal which need additional conditioning and does not come through a TIF at the test site. This TIF unit is optional and may or may not be in this cabinet. The output of the "TIF" would be patched to the input of the DIF (Digital Interface).

The next two panels down are the "TIF Range from Test Site" and the "TIF Range to MODACS" which allows for patching TIF Range control from any test site into either the "A" or the "B" MODCOMP. Each MODCOMP system will handle two TIF Range inputs and outputs and could control two separate TIF units. These are range control cables which allow the MODCOMP operator to adjust the TIF Range through menu driven software.

The next panel down contains the receptacles for the 12 auxiliary channels from each test site. The lower panel contains 2 video RG-59 and 6 coax RG-58 cables from each test site.

Cabinet 3. The static and dynamic DAS interface, digital signal connections and tachometer output are located in Cabinet 3 (fig. 8(c)). The top unit is a digital interface or "DIF." The DIF is used to interface any digital signal which is generated in the vicinity of the Control Room. For example, a Mensor digital pressure indicator or a tachometer output.

The next set of receptacles panel contains the static and dynamic DAS interface. The first two rows in this panel are the output from the NEFF 600 from the A-side (top row) and the B-side (second row). The next two rows are parallel connected and are the connections to the dynamic DAS (DDAS). This panel allows two different methods for signals to go to the DDAS. The DDAS can either obtain the raw signals from the MIF at the test site or the signals from the NEFF, either A- or B-side (fig. 9).

The next panel marked "DIF Multiplex Outputs from Test Site" contains the cables carrying the digital signals from the test sites. Test site 1 and test site 6 both have two digital cables. Each digital cable is carrying 8 digital channels. These receptacles can be patched to the DAU input to either MODCOMP "A" or "B" in the next panel down. This next panel is the "DAU Digital Input" panel which allows for 32 digital channels to be patched to either MODCOMP "A" or "B". Normally only 16 digital channels are available on each MODCOMP. To get 32 digital channels on one MODCOMP, two Digital Input Buffer (DIB) units have to be used. The DIB units are located in the MODCOMP cabinets which contain the NEFF 600's. Each DIB unit can handle 16 digital channels and each MODCOMP system can handle input from two DIB units.

Breakout panels, located in Cabinets 3 and 4, are available to allow access to an output signal of an individual analog channel out of a group of 16 channels or allow input of a signal into one of the 16 channels. These panels will be mounted in the patch cabinets as the need arises. These allow signal transfers only, no DC power is available at these breakout panels.

The "DAU digital input" panel plugs are marked according to the 8 digital channels into which they are wired. The digital signal is patched from the panel "DIF Multiplex Outputs from Test Site" to the desired channel on the DAU "A" or "B" input panel. The first DIF input is MODCOMP channel 97 through 104. The second DIF input goes into channels 105 through 112 .

The last panel contains the tachometer leads from the test sites and is marked "TACH from Test Site." There is one lead from each test site and each lead carries 8 TACH channels. These cables are identical to the analog cables and could be used as an extra analog cable if needed. They were intended to carry the conditioned TACH signal from each test site.

Cabinet 4. The last cabinet, Cabinet 4, contains the analog signal connections (fig. 8(d)). The first panel marked "Analog Inputs" handles the analog signals from each test site. The first row carries a spare analog cable from Test Sites 1 through 4.

At the top of the cabinet are usually one to two breakout panels. The next 2 rows carry 6 analog cables from test site 1 which is the tunnel test section. The other test sites (test sites 2 to 6) are appropriately labeled. Each analog cable contains sixteen channels.

The lowest panels marked "Analog Inputs", "DAU A" and "DAU B" are the analog inputs to the MODCOMP systems. The analog signal from the various test sites are patched to the "DAU Analog Inputs". The "DAU A" and DAU B" input plugs are labeled to indicate the MODCOMP channels to which they are connected.

Normally, most tests will be set-up utilizing analog channels 1 thru 48. There is the possibility of using two MIF cabinets at a test site and utilizing the full 96 analog channels. For example, MIF cabinet 1 might be in the first 48 channels, 1 thru 48, and MIF cabinet 2 could use the second 48 channels, 49 thru 96. There may be occasions where the 48 analog channels in the MIF cabinet will patch to the DAU inputs 49 thru 96. It is important to be sure which cables are connected at the MIF cabinet and which cables are patched into which DAU analog inputs in cabinet 4.

Concluding Remarks

The 14- by 22-Foot Subsonic Tunnel has demonstrated that using the Model Interface (MIF) and Plugboard cabinets to connect the wind tunnel model instrumentation to the Data Acquisition System (DAS) is an efficient and flexible method to deal with the many instrumentation requirements of wind tunnel testing. During model assembly in the Model Preparation Area (MPA), the instrumentation is connected to a MIF cabinet and is then connected to the plugboard cabinets and the Data Acquisition System. After assembly and check-out, the model on a model support cart, with MIF cabinet alongside, is moved into the wind tunnel The MIF cabinet is disconnected at the MPA and reconnected in the wind tunnel. This method saves time and effort because instrumentation cables do not have to be reconnected and the MIF patchboard does not have to be reconfigured. The system is also versatile in that the MIF cabinet instrumentation can be tailored to each particular test and each test can be connected to different parts of the DAS.

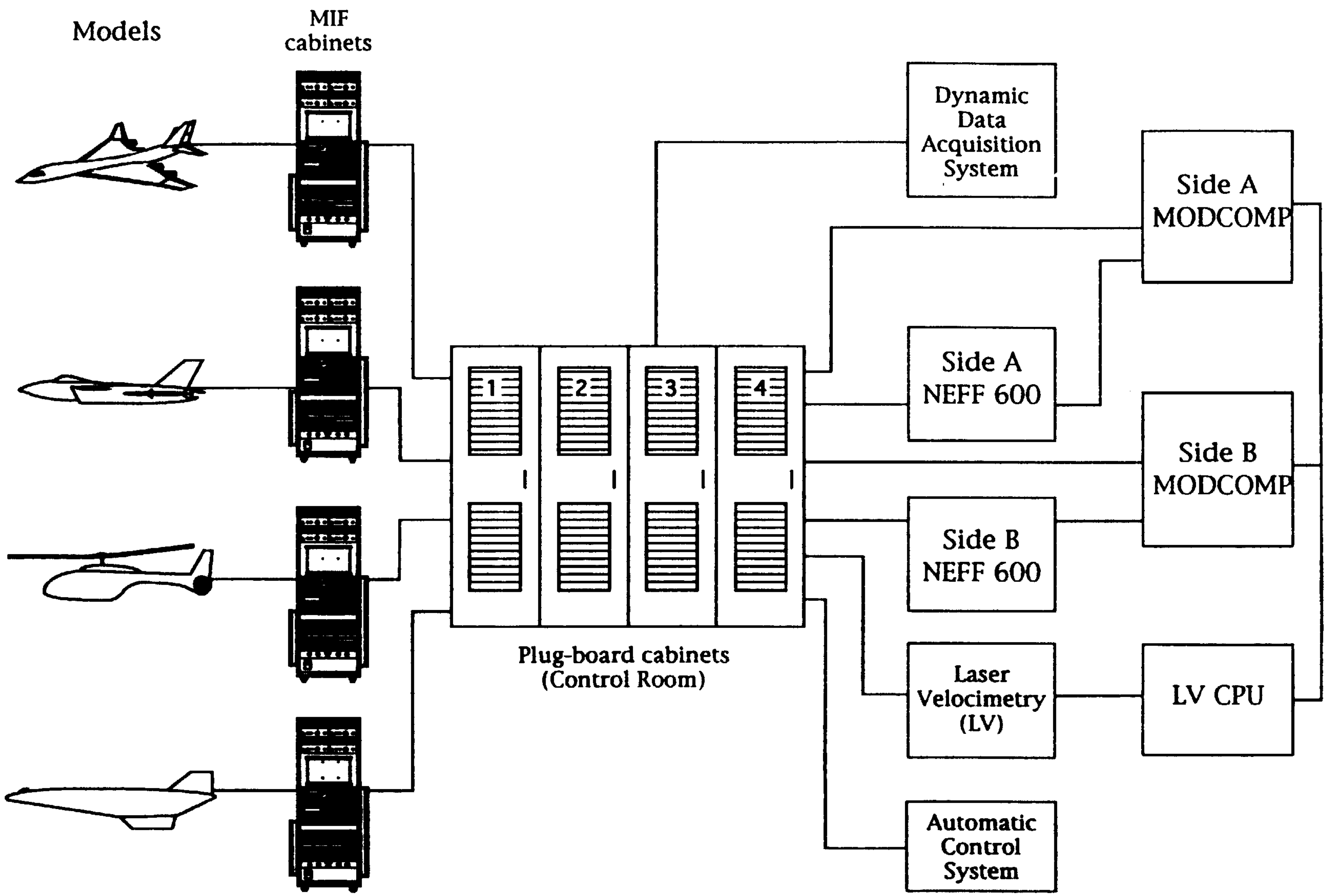
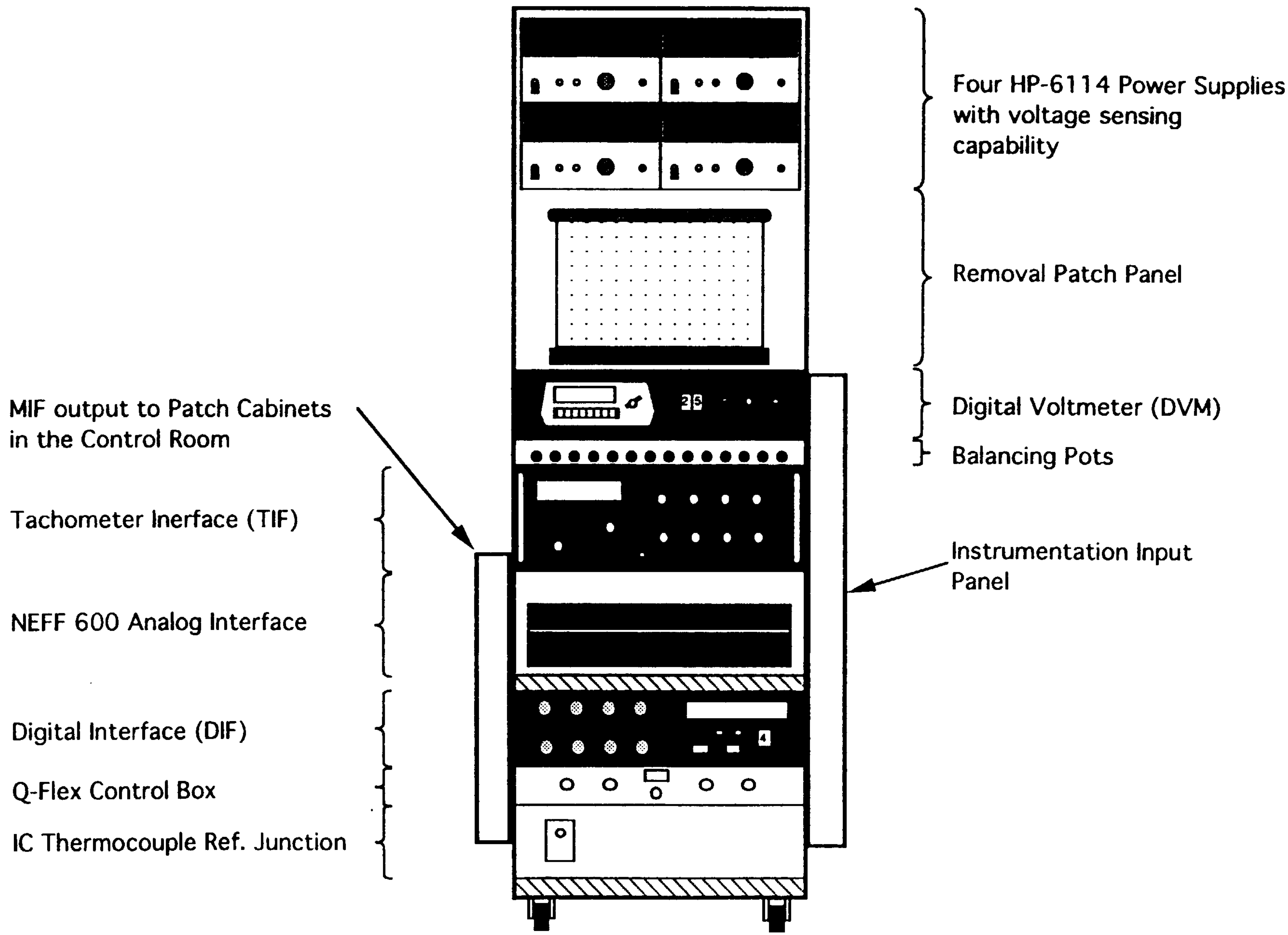
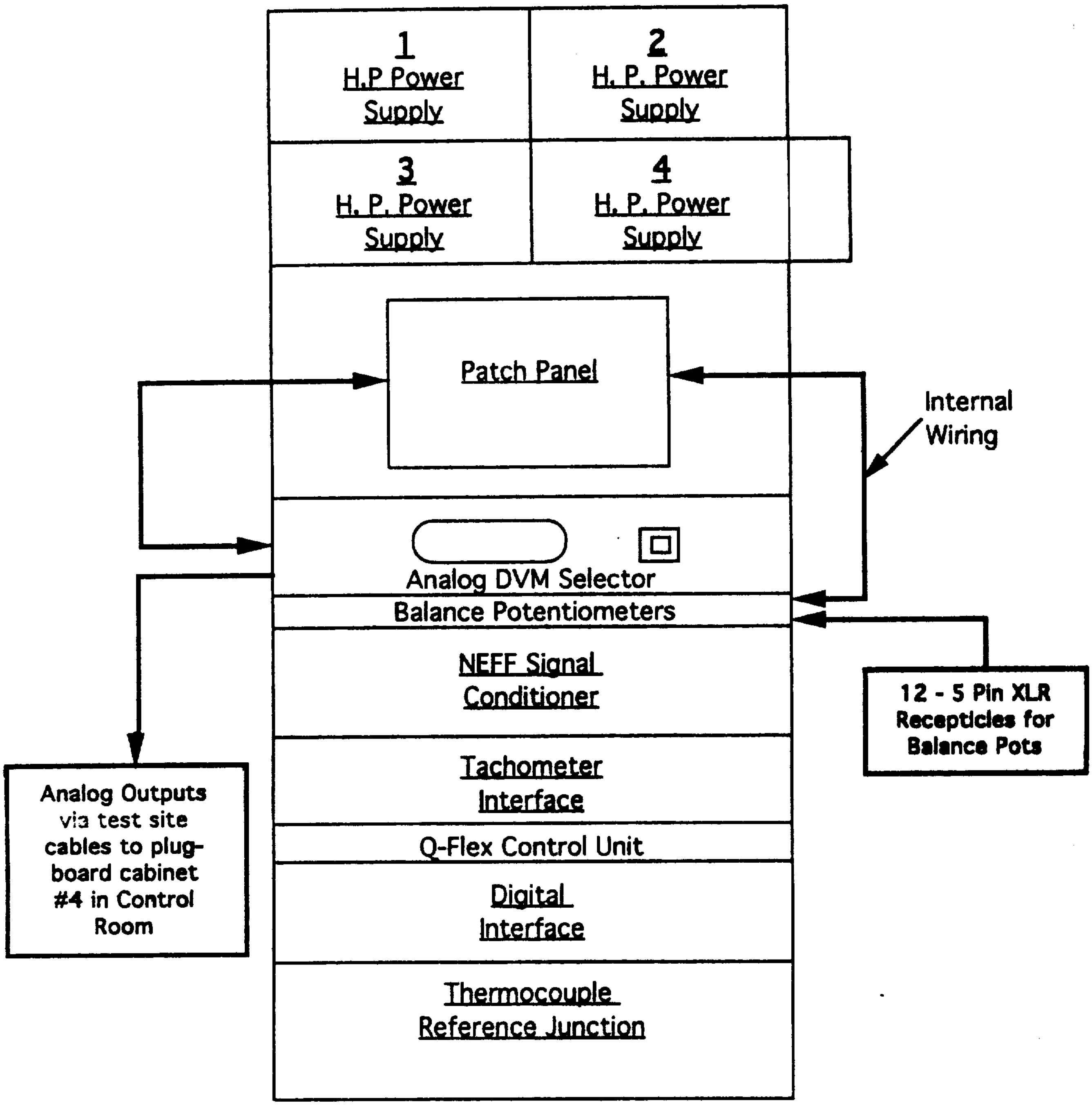


Figure 1. - Diagram of the Model Interface and Plugboard Cabinets in the Data Acquisition System.



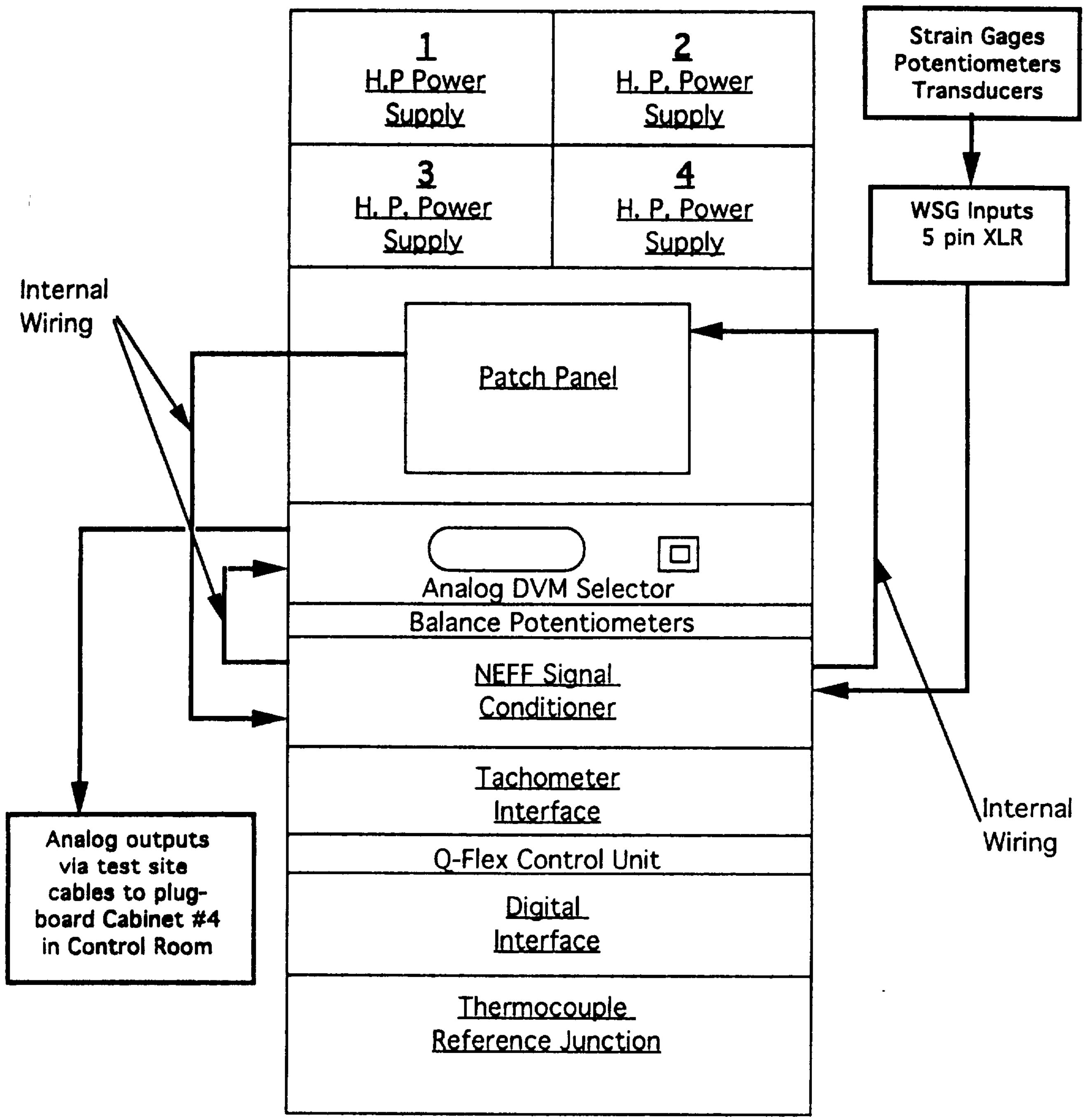
(a) Sketch of MIF Cabinet.

Figure 2. Model Interface Cabinet (MIF).



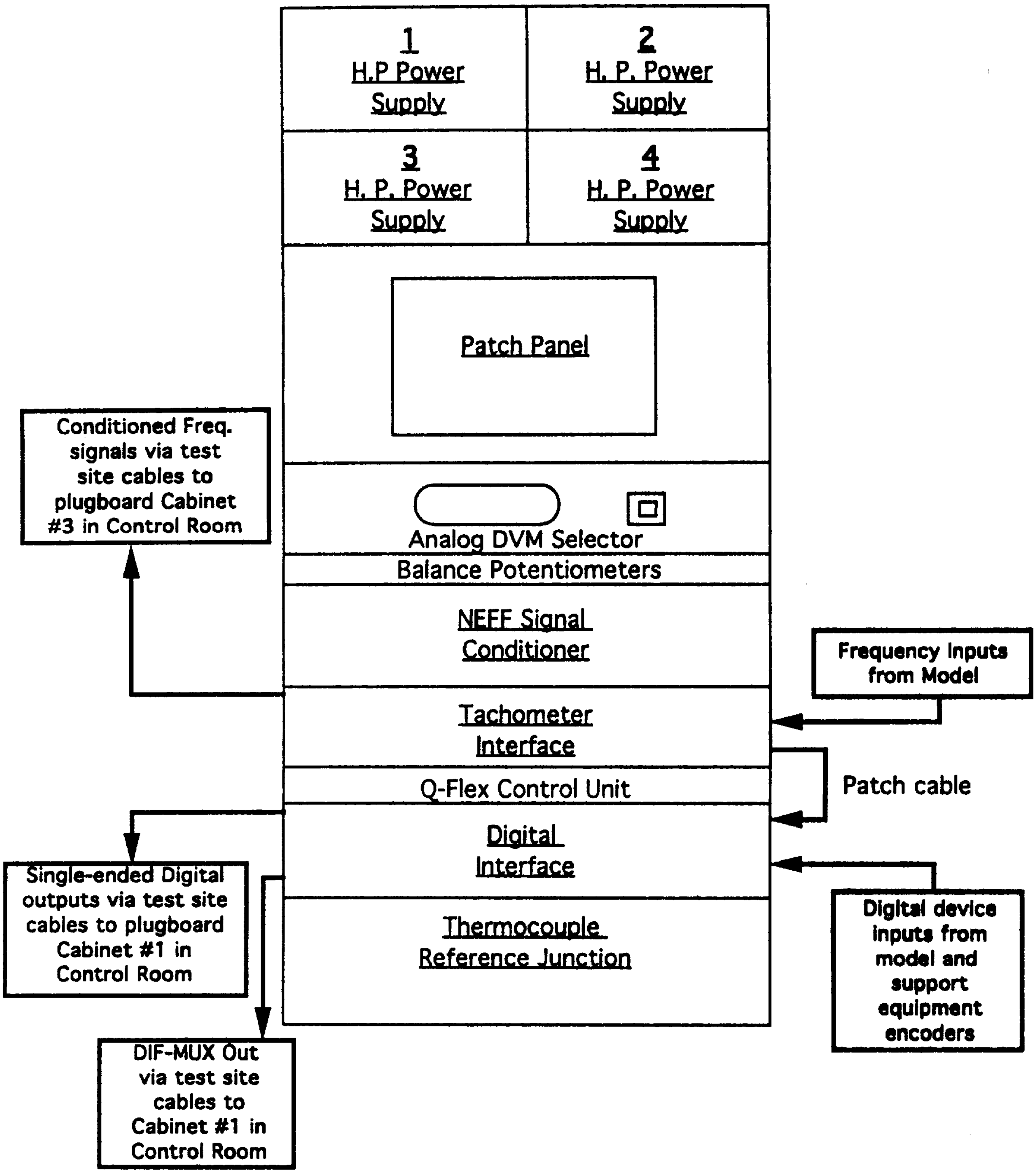
(b) DVM and Balance Potentiometer Signals Input and Output Connections.

Figure 2. Continued.



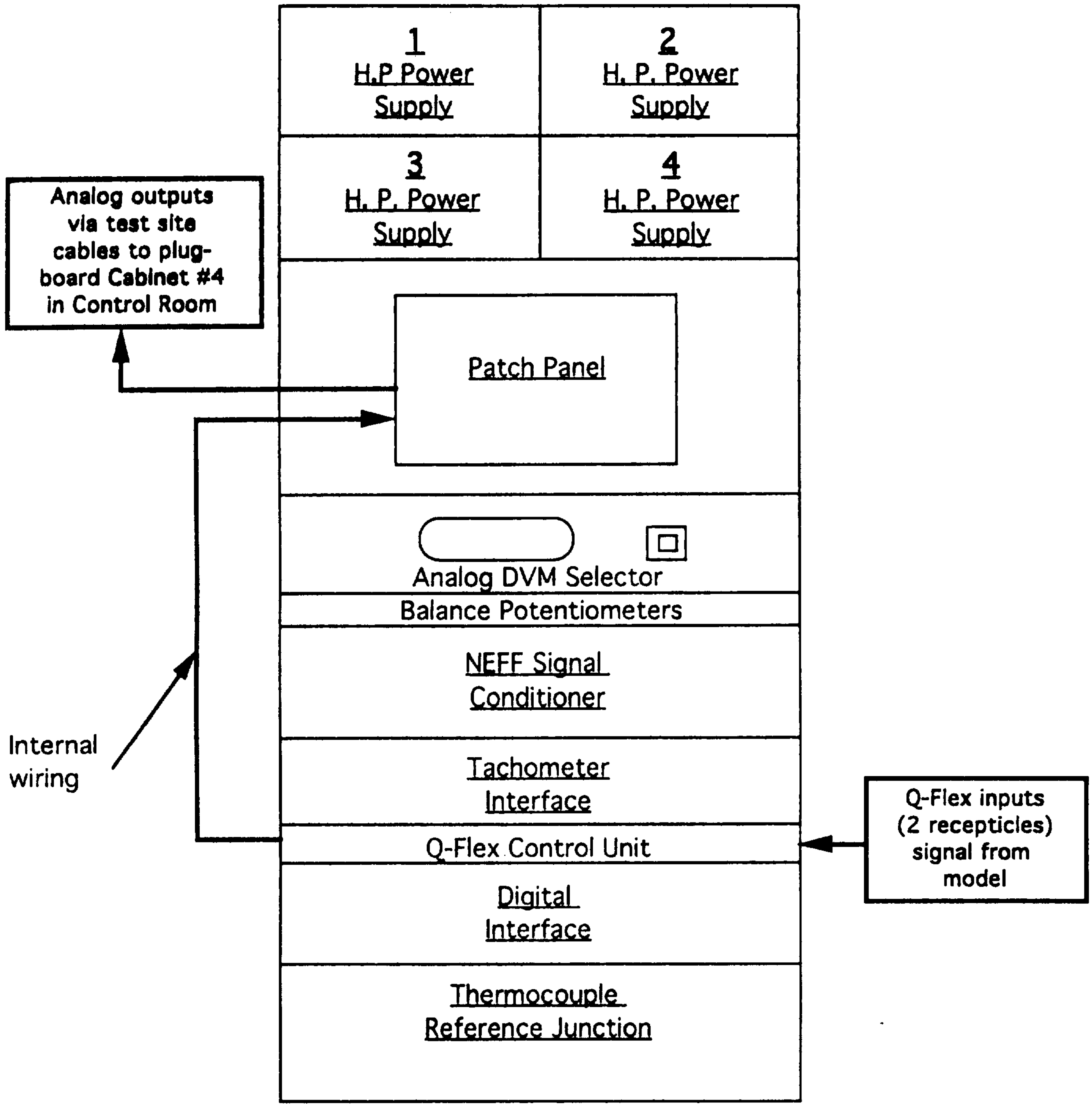
(c) Analog Signals Input and Output Connections.

Figure 2. Continued



(d) Tachometer and Digital Signal Input and Output Connections.

Figure 2. Continued.



(e) Q-Flex Attitude Transducers
Input and Output Connections.

Figure 2. Concluded.

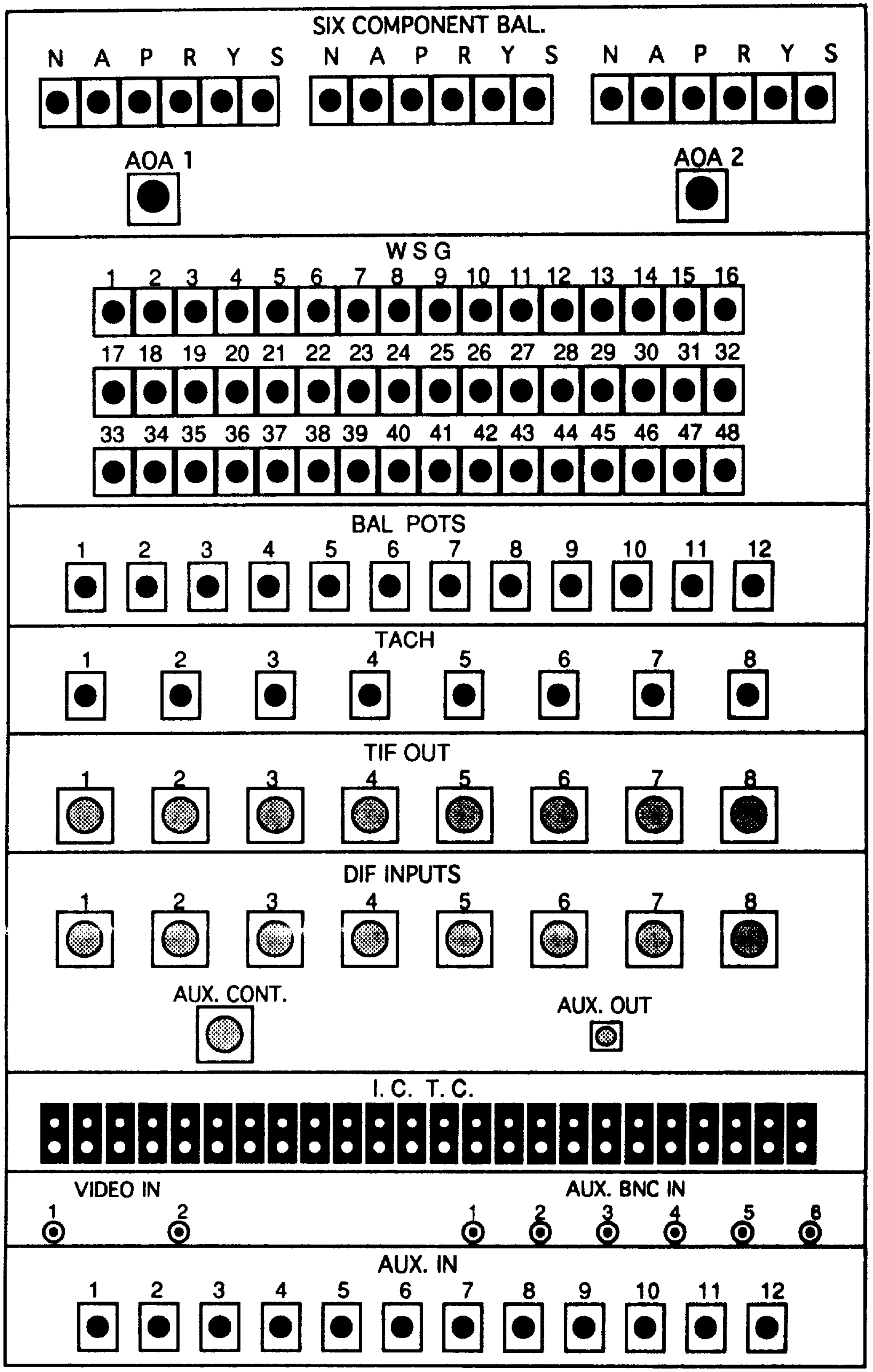


Figure 3. MIF Cabinet Input Panels.

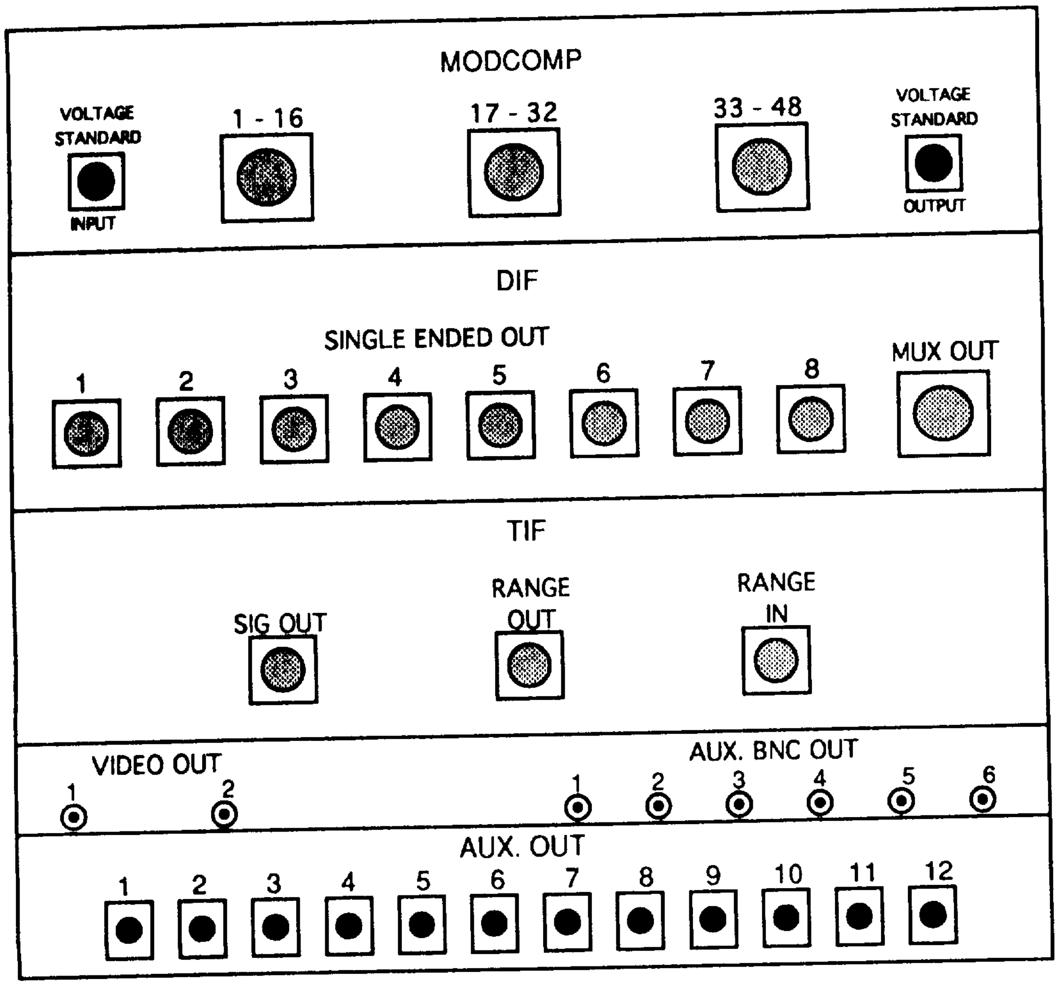


Figure 4. MIF Cabinet Output Panels.

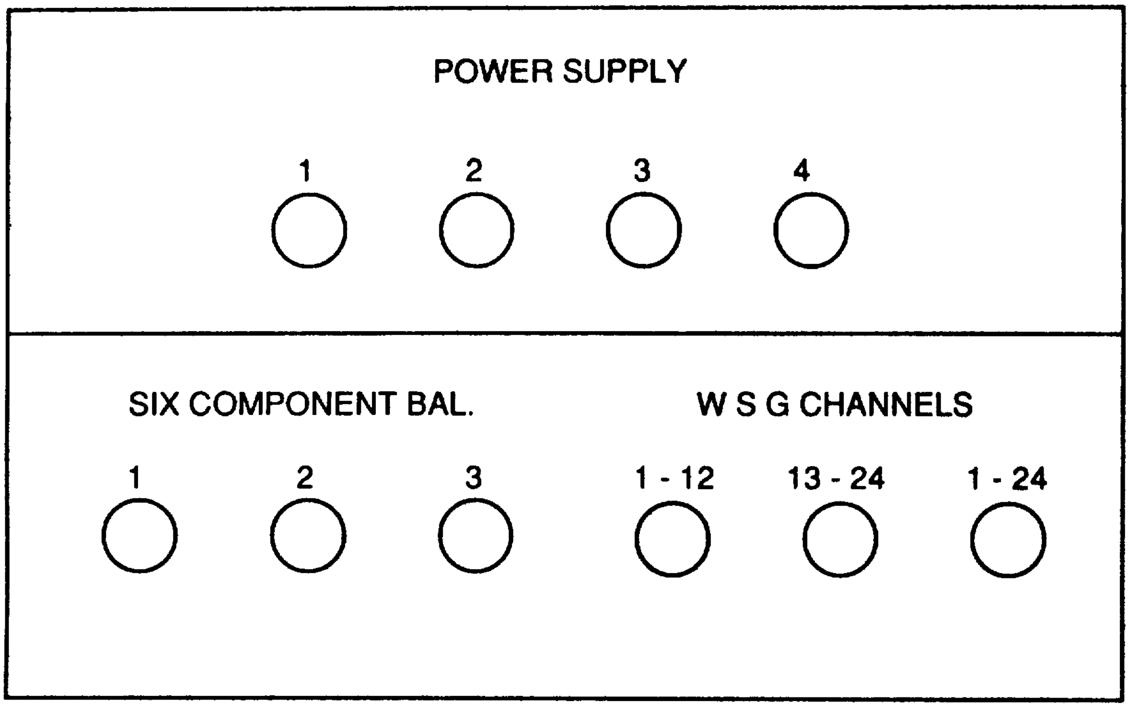
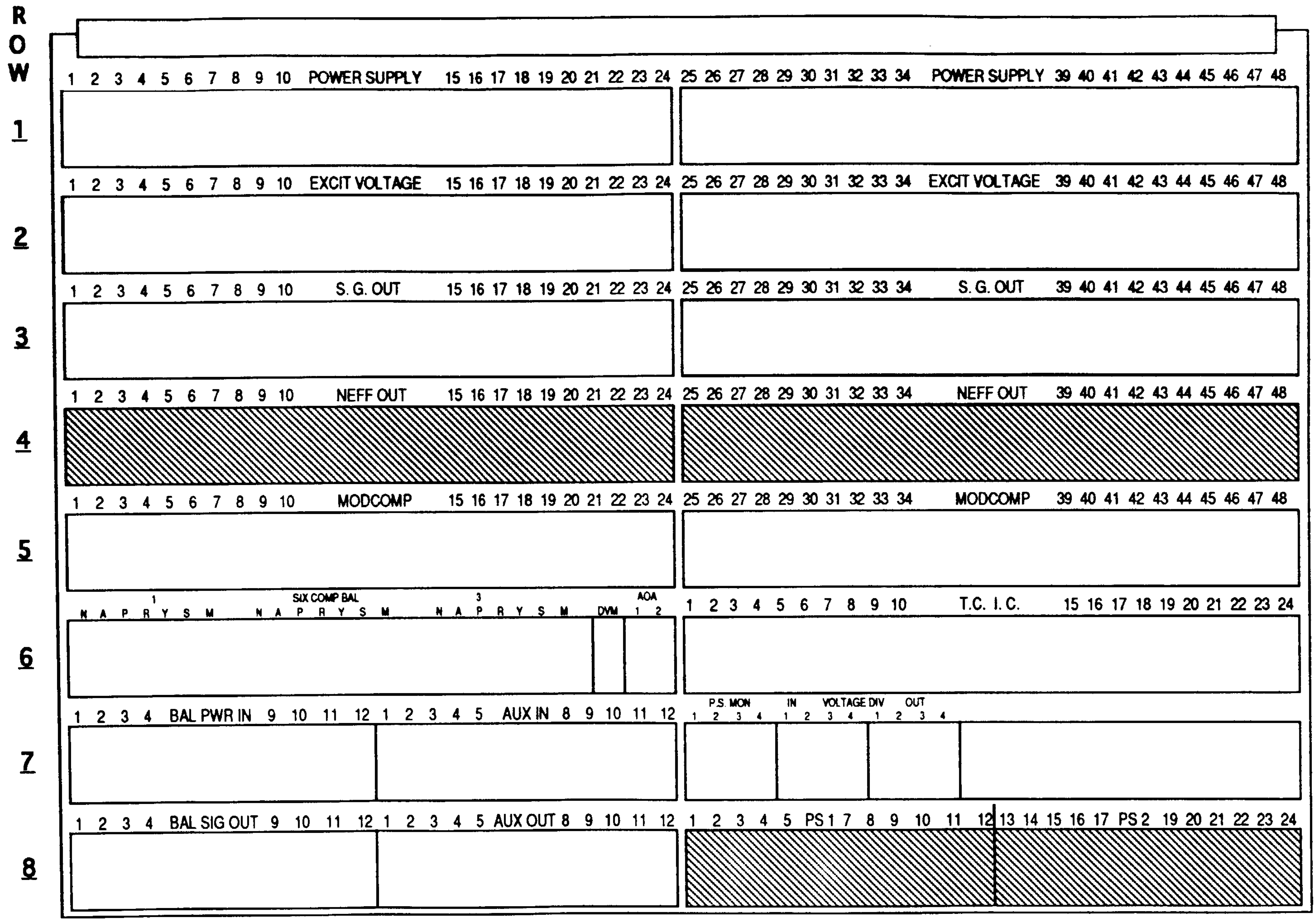
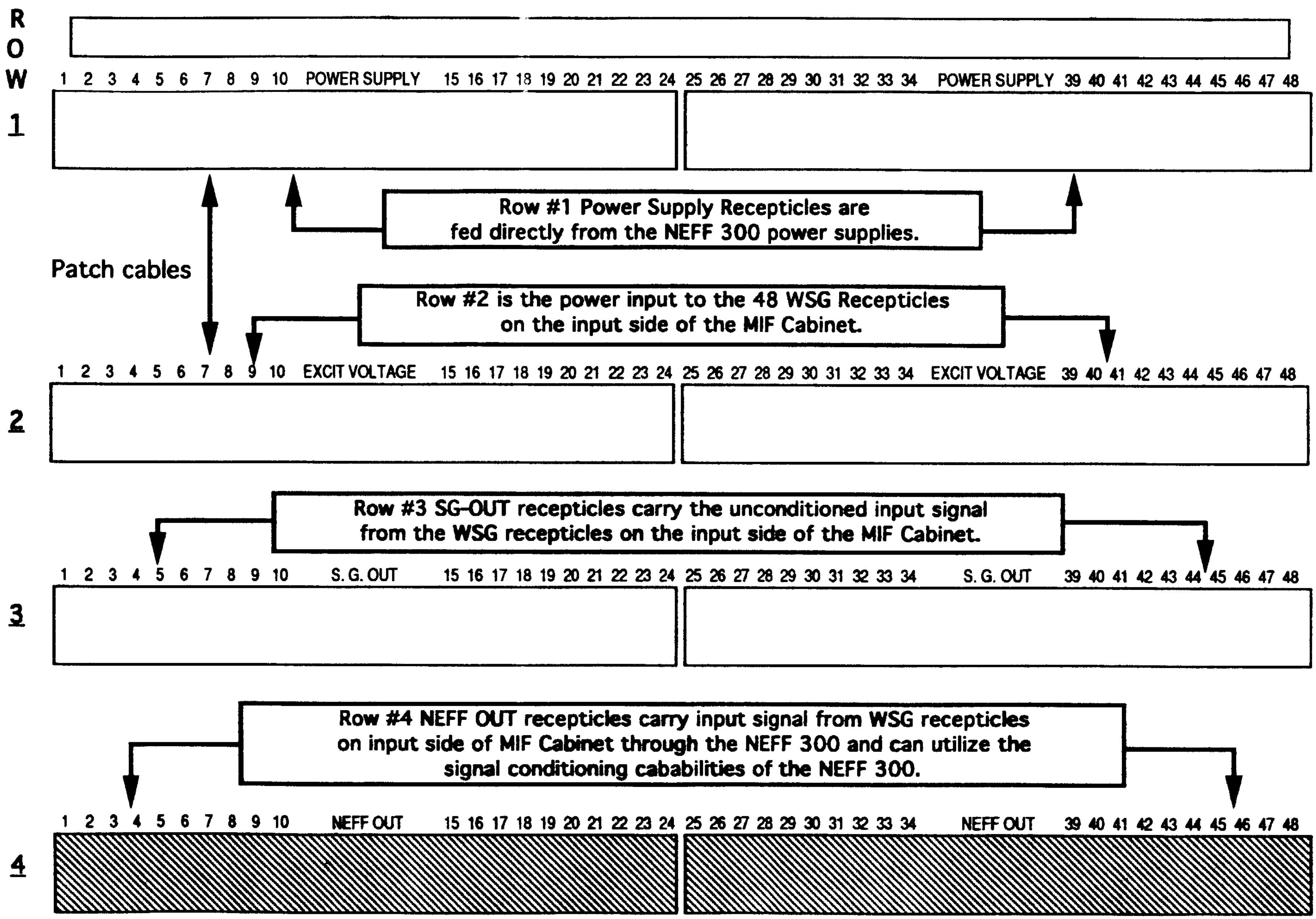


Figure 5. Power Supply Distribution Panel
(In upper rear portion of MIF Cabinet).

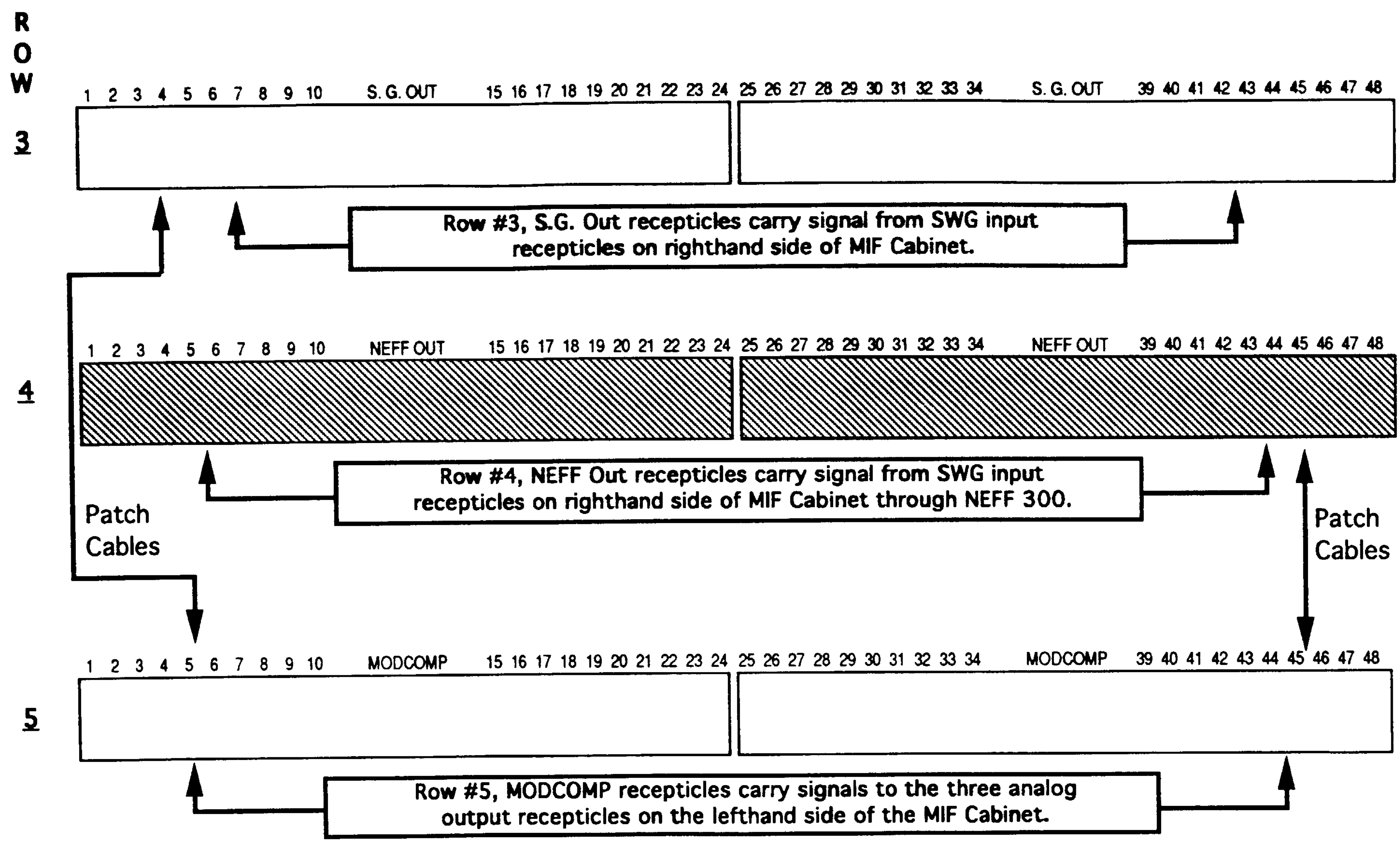


(a) General Arrangement

Figure 6. MIF Cabinet Patch Board.

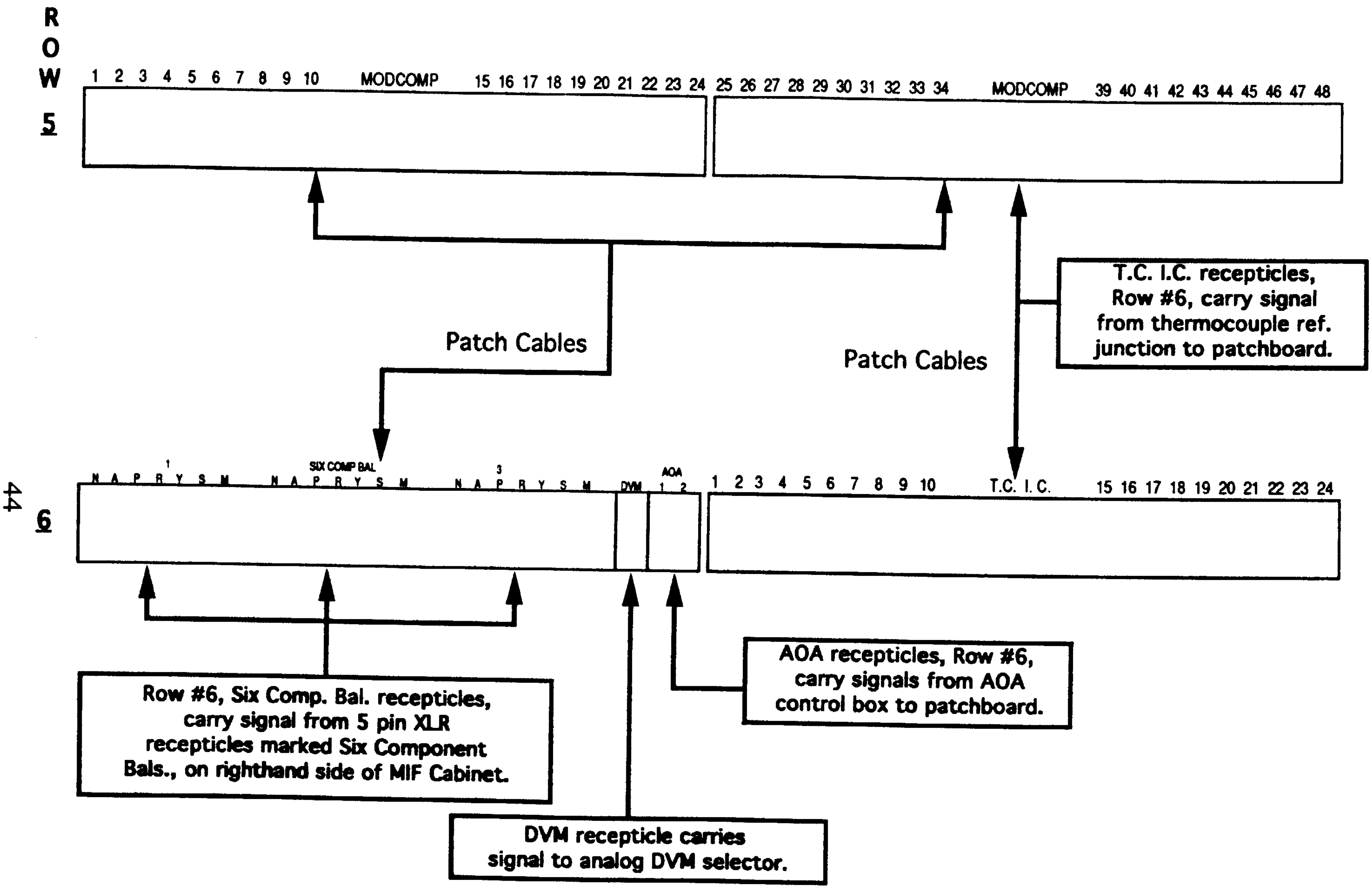


(b) General Analog Signal Patching for Power and Output.
Figure 6. Continued.



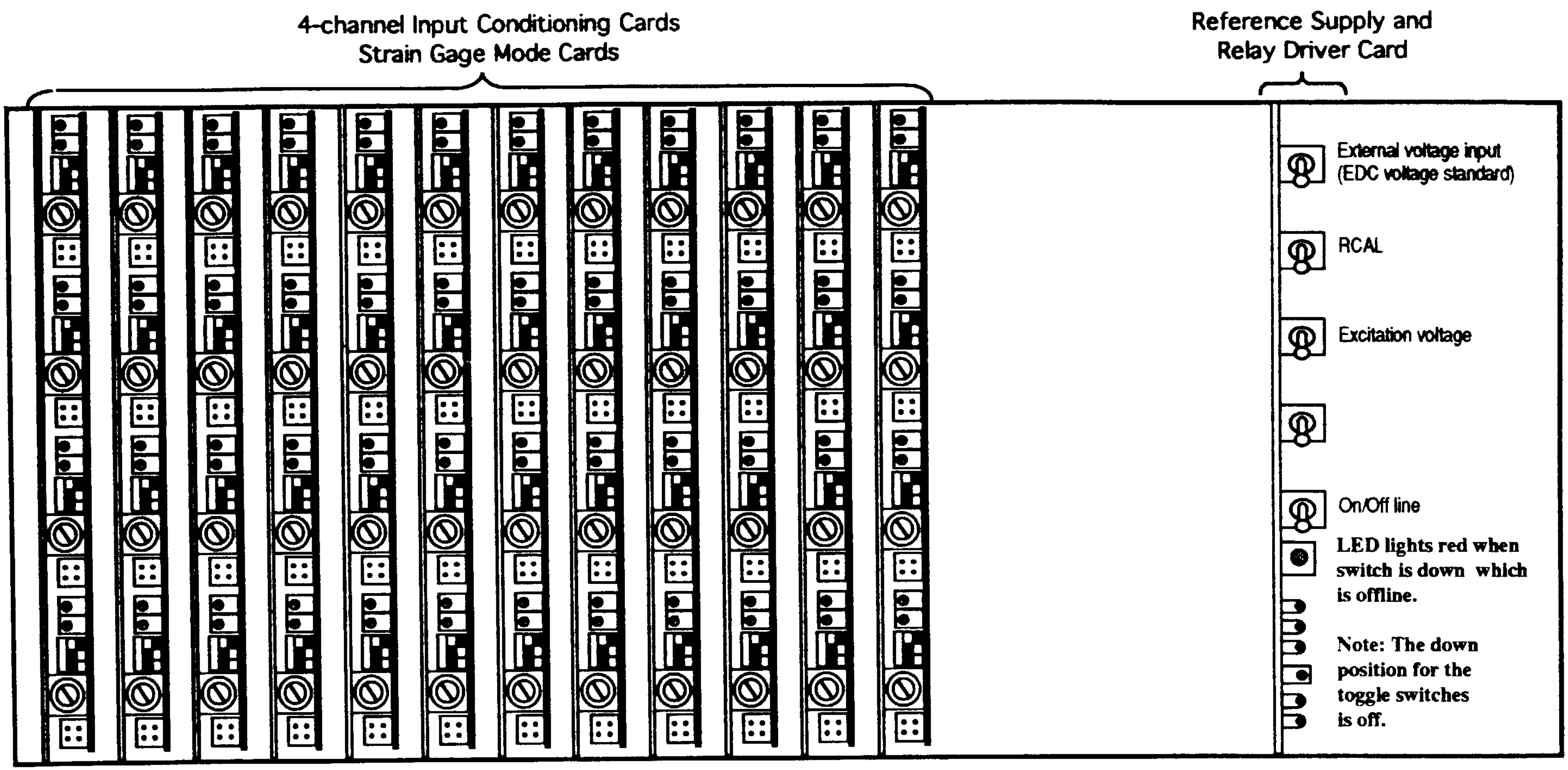
(c) Analog Output Signals to the MODCOMP.

Figure 6. Continued.



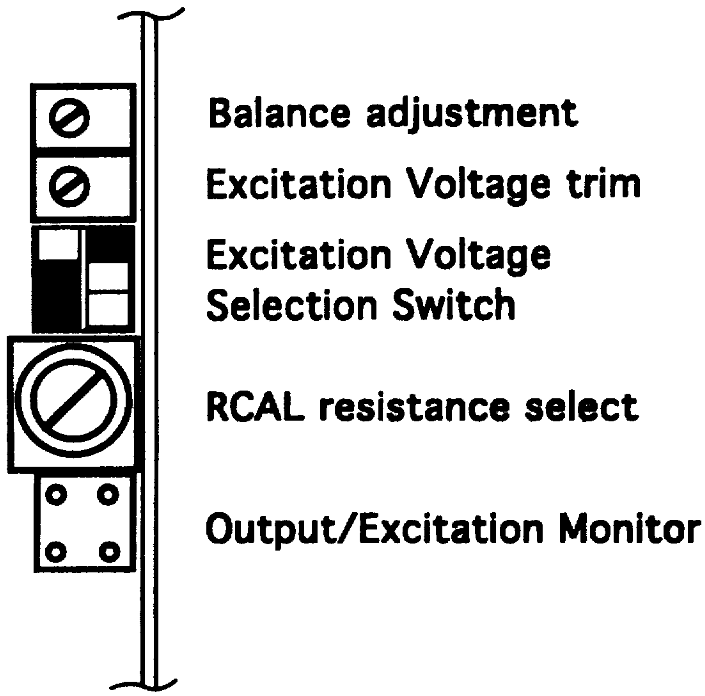
(d) Output Signals from Balances, AOAs, and Thermocouples to MODCOMP.

Figure 6. Concluded.



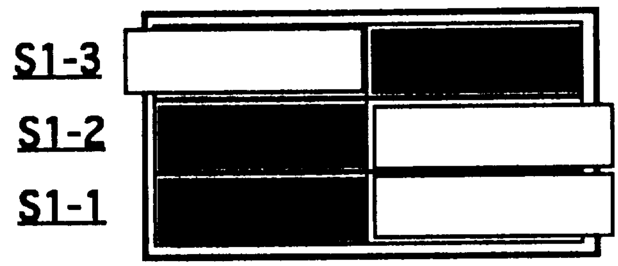
(a) General Internal Arrangement.

Figure 7. NEFF 300 Signal Conditioner in MIF Cabinet.



(b) Detail of one channel on the Mode Card.

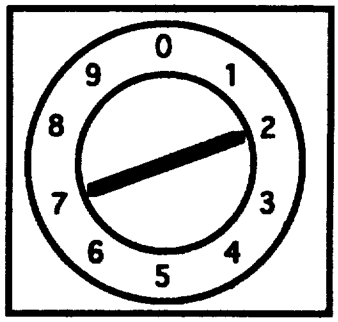
Figure 7. Continued.



Excitation Voltage Switch Setting				
Excitation Voltage	2v	5v	7v	10v
S1-3	Right	Left	Left	Left
S1-2	Right	Right	Left	Left
S1-1	Right	Right	Right	Left

(c) Detail of the Excitation Voltage Selection Switch in each channel on a Mode Card.

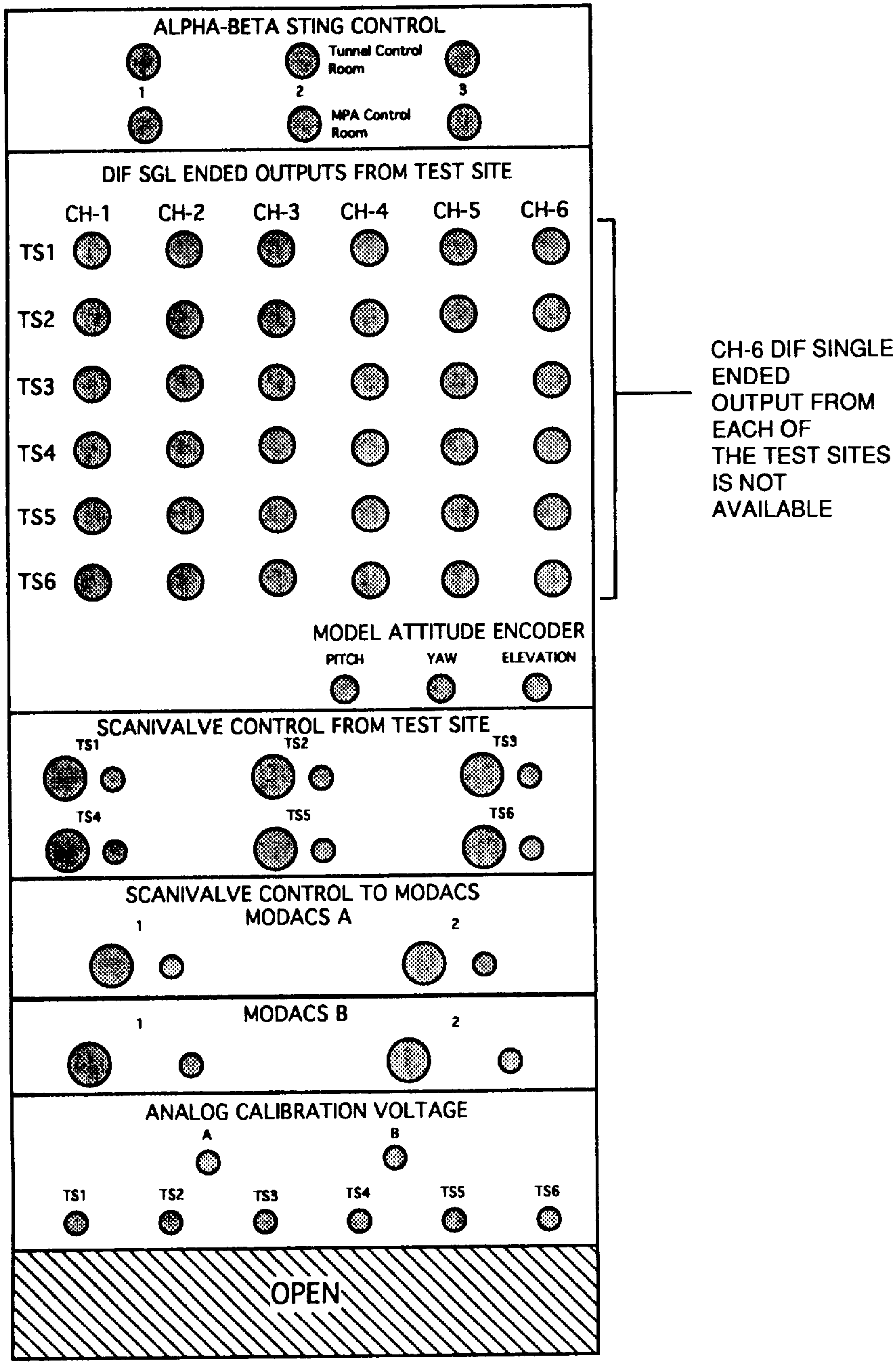
Figure 7. Continued.



S2 Switch Position	RCAL Resistance
0	User Installed
1	2.56M ohm
2	1.28M ohm
3	640K ohm
4	320K ohm
5	160K ohm
6	80K ohm
7	40K ohm
8	20K ohm
9	10K ohm

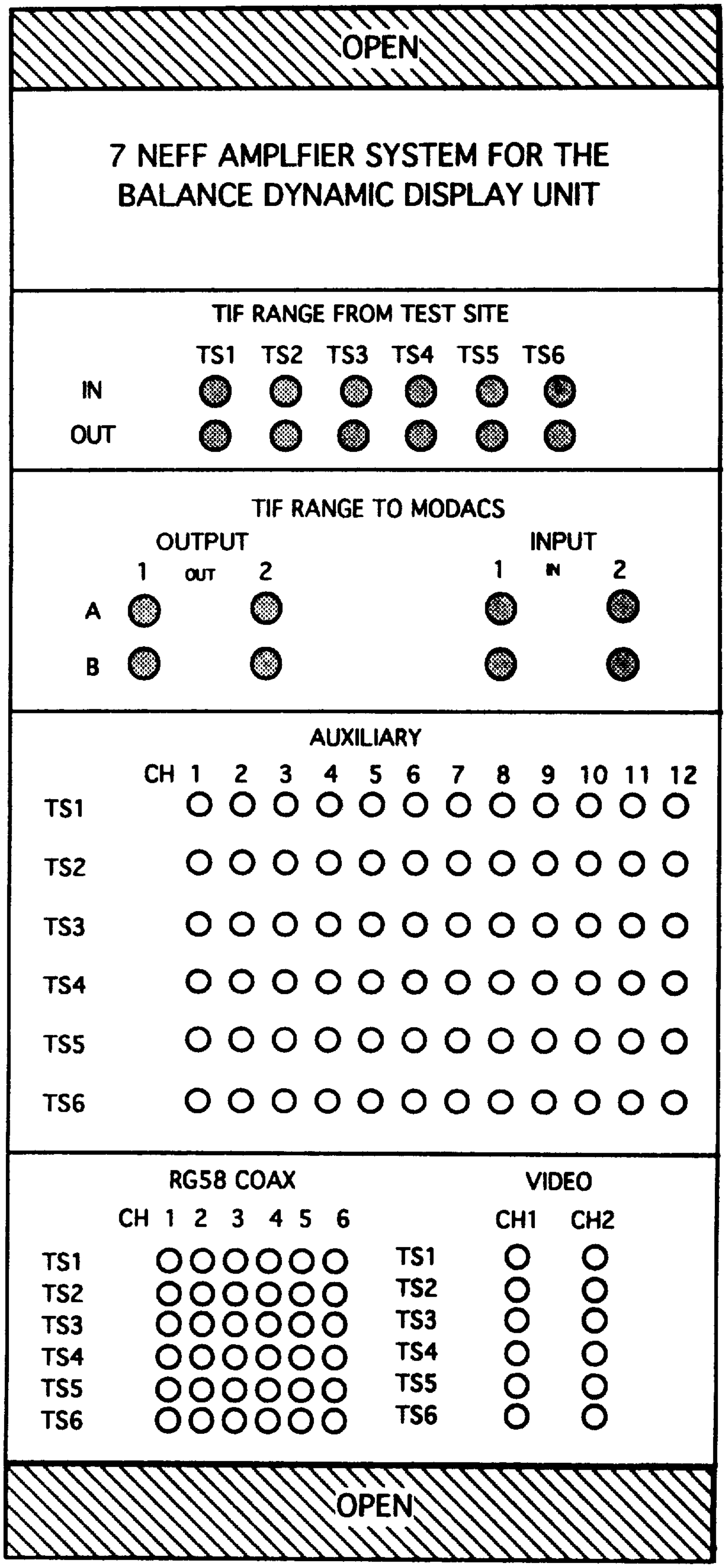
(d) Detail of RCAL Resistance Selector Switch
for one channel on the Mode Card.

Figure 7. Concluded.



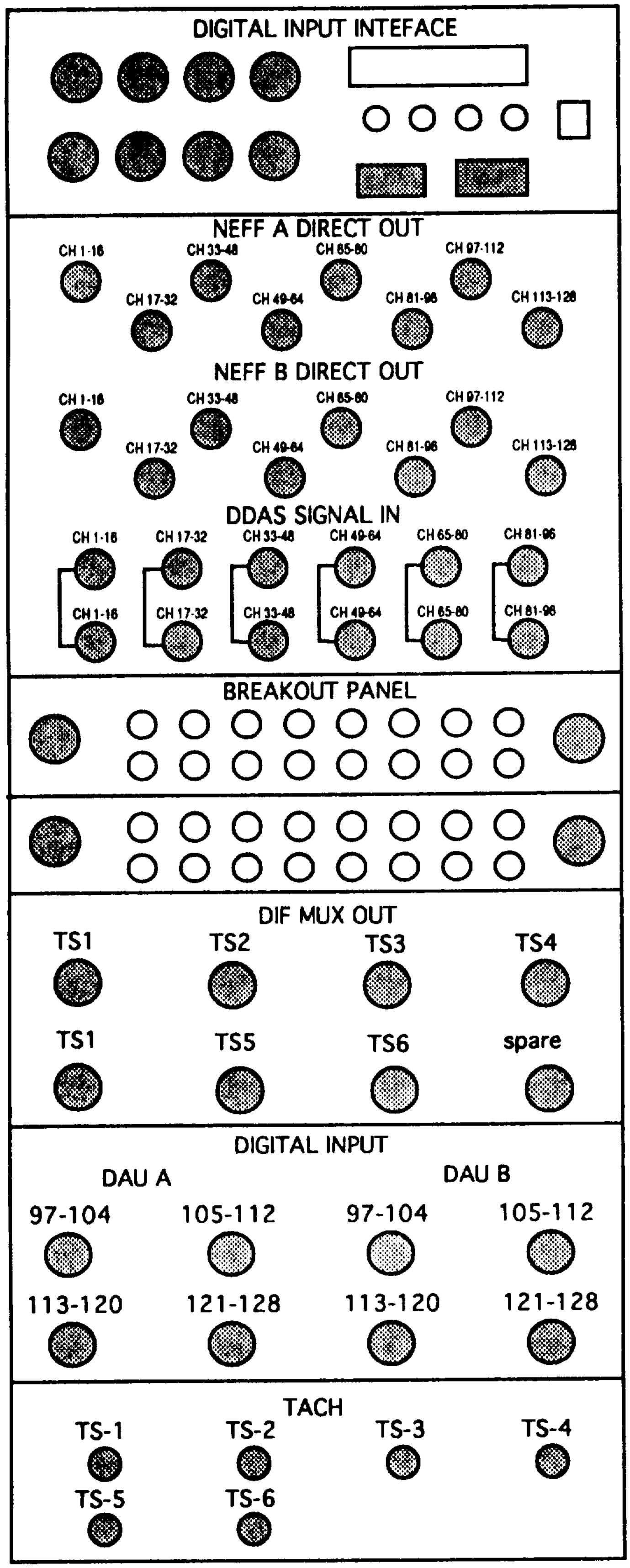
(a) Cabinet #1.

Figure 8. Sketch of Plugboard Cabinets in Control Room.

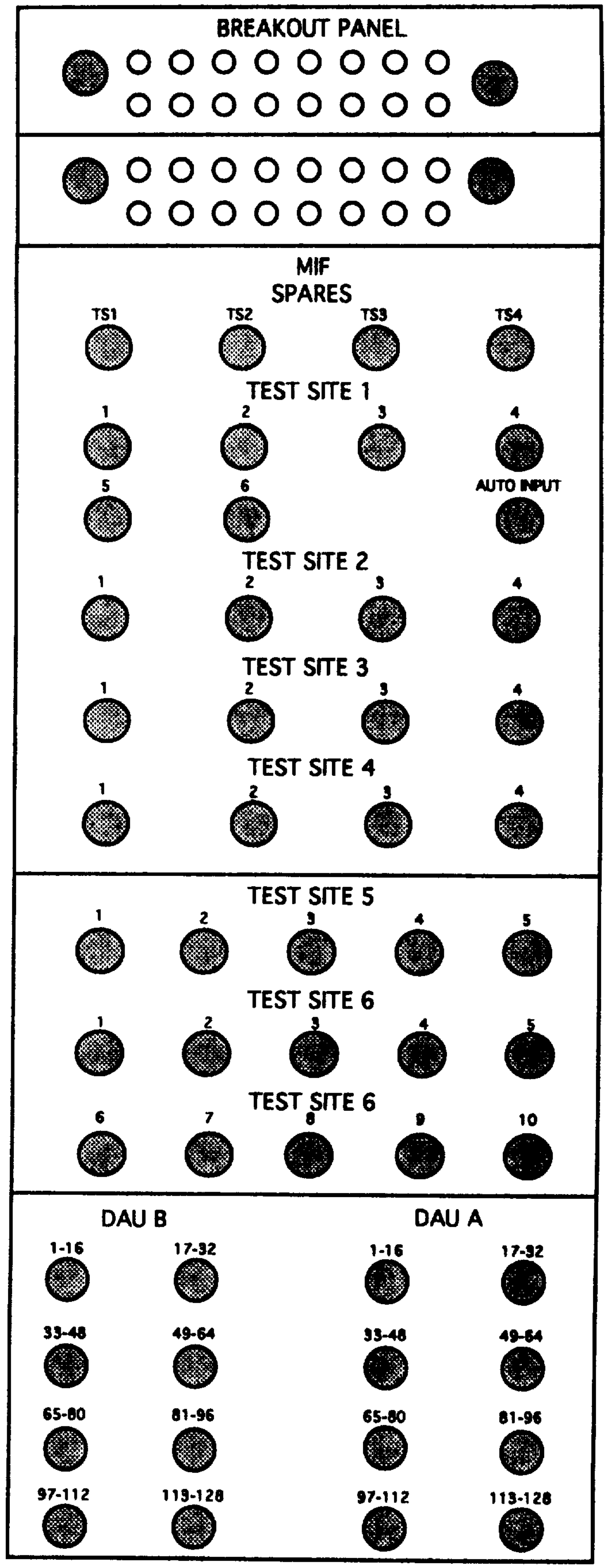


(b) Cabinet # 2

Figure 8. Continued.



(c) Cabinet 3.
Figure 8. Continued.



(d) Cabinet 4.

Figure 8. Concluded.

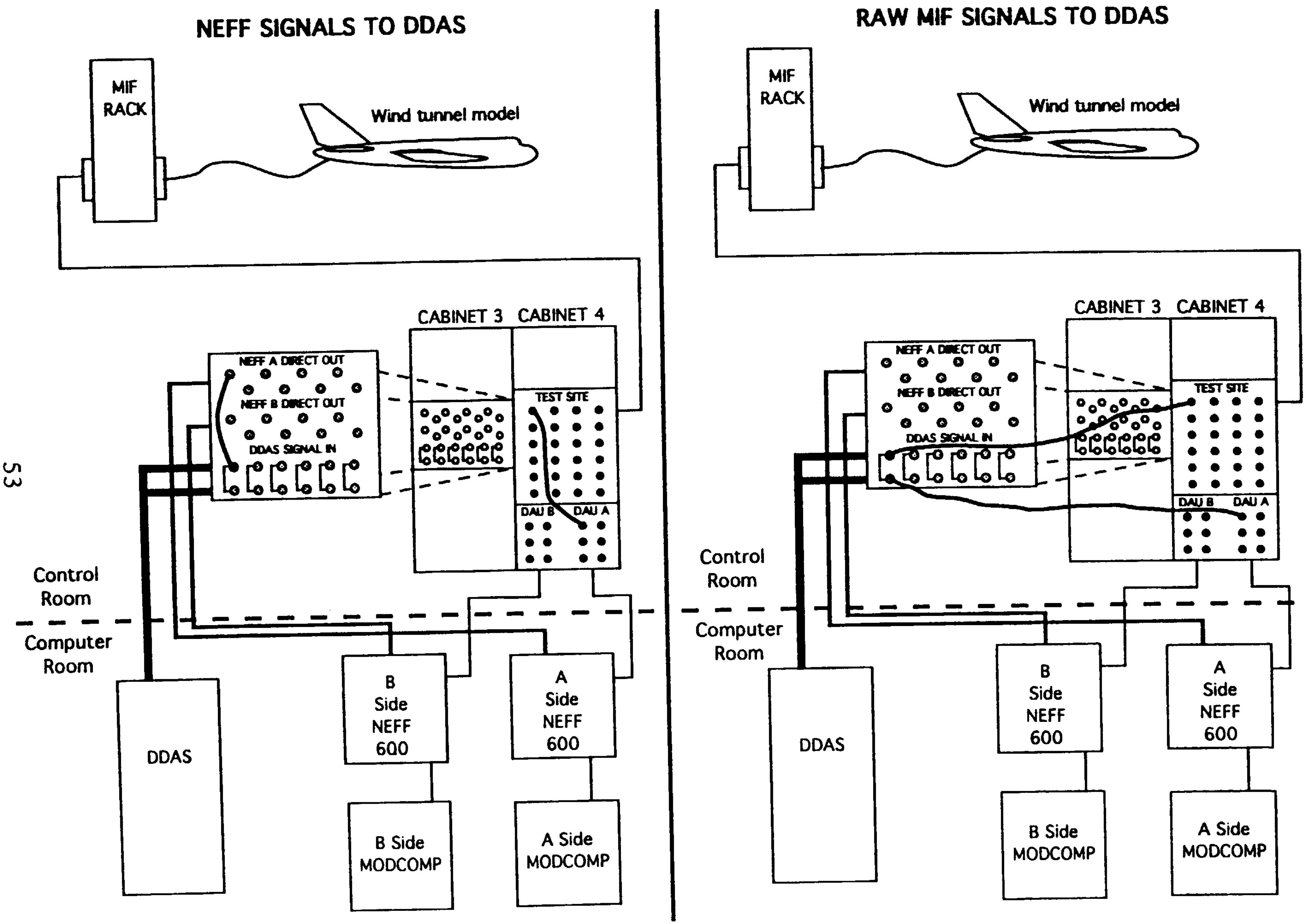


Figure 9. Arrangement for Analog Channels from Model to Dynamic Data Acquisition System.

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13. ABSTRACT ***(Maximum 200 words)***

The primary method of connection between the wind tunnel model instrumentation and the data acquisition system in the 14- by 22-Foot Subsonic Tunnel is through the Model Interface (MIF) and Plugborad cabinets. The MIF and Plugboard cabinets allow versatility in the connection of the instrumentation to the different data systems in the facility. The User's Manual describes the components inside the MIF cabinet, the input and output of the MIF, the MIF patchboard, and the Plugboard cabinets. There are examples of standard connections for most of the instrumentation used in the facility.

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